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The Public Lighting Tables of the American Meter Company will be found in the page advertisement of that Company.

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[OFFICIAL NOTICE.]

Nineteenth Annual Meeting, Western Gas Association.

OFFICE OF THE SECRETARY,
NEW ALBANY, IND., May 5, 1896.

The nineteenth annual meeting of the Western Gas Association will be held at Lookout Mountain, near Chattanooga, Tenn., May 20, 21 and 22, 1896, and will be called to order by the President, Mr. A. W. Littleton.

Lookout Inn will be the Association headquarters, and the business sessions will be held in a detached building, closely adjoining the hotel.

The rates at Lookout Inn will be from $2.50 to $4 per day, with a special rate of $2 per day for the wives of the members who may be present.

The Executive Committee met at St. Louis last January, and, as a result, the following papers will be presented for the consideration of the members:

"Self-Education in Gas Engineering," by Mr. Alex. C. Humphreys, New York City.

"Municipalities vs. Gas Companies: Their Reciprocal Relations," by General A. Hickenlooper, Cincinnati, O.

"The Future of the Gas Business in America," by Mr. M. S. Greenough, Cleveland, O.

"How will the Manufacture of Calcium Carbide Affect the Gas Business?" by Mr. Fred. Bredel, Milwaukee, Wis.

"The (Alleged) Law of Inverse Squares," by Mr. B. E. Chollar, St. Louis, Mo.

"Wrinkle Department," edited by Mr. Geo. T. Thompson, St. Louis, Mo.

"A Few Words on Naphthaline," by Mr. John Gimper, Galveston, Tex.

The Southern States' Passenger Association, Central Passenger Committee, Chicago and Ohio River Traffic Association, Trunk Line and Chicago and Alton R. R., from all points in Illinois, have granted the usual rate of 1⅓ fare, on the certificate plan, for the round trip to *Chattanooga*, conditional on 100 certificates being presented to the Secretary.

The territory embraced by the Southern States' Passenger Association includes all lines east of the Mississippi river and south of the Ohio and Potomac rivers.

The territory of the Central Passenger Commitee and the Chicago and Ohio River Traffic Association is bounded, on the east, by Pittsburgh, Salamanca, Buffalo and Toronto, on the north by the line of, and including points ont he Grand Trunk Railway from Toronto to Port Huron; thence, via Lake Huron and Michigan, to the north line of Cook county, Ills.; on the west, by the west line of Cook county and the Illinois and Mississippi rivers to Cairo, including Burlington, Keokuk, Quincy, Hannibal and St. Louis; and on the south, by the Ohio river, but including all points on either side of that river.

The Trunk Line territory is as follows: From Niagara Falls, Buffalo and Salamanca, N. Y., Pittsburgh, Pa., Bellaire, O., Wheeling, Parkersburgh and Charleston, W. Va., and points east thereof, except in New England.

All persons availing themselves of the reduced rates will apply to agent at least 30 minutes before departure of train. Certificates in accordance with above arrangement will not be honored, returning home after May 26. All ticket agents do not have a supply of certificates, but they may be obtained by request, if notification is made in time.

The New England Passenger Association refused the request for reduced rates. All persons in the above territory, or territory not embraced by the Passenger Associations mentioned, will purchase tickets to nearest important station in one of said Associations, and from there receiving from the ticket agent a certificate stating that full fare had been paid to Chattanooga, which certificate must be given to the Secretary before the afternoon of Thursday, May 21, so that the Agent of Southern States' Passenger Association may sign certificate, which will entitle the purchaser of ticket to a one-third rate from Chattanooga, returning to the station from which ticket was purchased, providing 100 certificates are presented for signature.

All tickets must be purchased to Chattanooga, and *not* to Lookout Mountain. The various Passenger Associations grant reduced rates only to Chattanooga, from which place Lookout Mountain can be reached by the Chattanooga and Lookout Mountain R.R., which con-

purchase a first-class ticket to Chattanooga, paying for same full fare, nects, at Union and Central Depots, with all the principal trains from the North and West. Mr. M. S. Gibson, Manager of Lookout Inn, agrees to take charge of all baggage at Chattanooga and relieve our members of the responsibility of rechecking. He writes as follows: "We shall have men at the Union and Central Depots in Chattanooga to receive the checks of your members when they arrive there, and take charge of their baggage, bringing it directly to the Inn, relieving them of all care and responsibility. Our standard gauge train leaves both the Union and Central Depots on the arrival of the principal trains from the North and West, so that passengers can be transferred directly from their trains to our train and taken to the Mountain in 40 minutes' time after their arrival. If the members or any of them arrive on trains that we do not connect with, our porters will be there to show them the way to the electric cars, which run every 15 minutes from the depots in Chattanooga to the foot of the Mountain, there connecting with the new 'Incline No. 2,' which will bring them directly to the door of the Inn, and is a very pleasant way of getting to the Mountain. These cars run every 15 minutes, from 7 A.M. to 10 P.M., and later if desired. All you have to do is to inform your members that, if they will make themselves known when they arrive in Chattanooga, we will see that they arrive at their 'haven of rest' without delay or difficulty. The fare from Chattanooga to Lookout Inn, via Lookout Mountain and Chattanooga Railroad, is 30 cents; round trip, 50 cents."

Mr. James Forbes, Chairman of Committee of Arrangements, announces that he or Mr. I. S. Post will meet the special train, which will be run from Cincinnati, under the direction of Mr. E. H. Jenkins, Supt. Gas Company, Covington, Ky. He will also meet the delegation from St. Louis. Mr. Forbes also states that "Incline No. 1" will give a low round trip rate, and will deliver all baggage from foot of "Incline" to Lookout Inn free of charge. Checks can be given to the Transfer Company's agent, who will also give a special rate from train to foot of "Incline No. 1," and return.

A meeting of the Board of Directors of the Association will be held at Lookout Inn, at 8 P.M., Tuesday, May 19. The following members are Directors: I. C. Baxter, Wm. McDonald, Geo. T. Thompson, Irvin Butterworth, W. M. Eaton, Geo. H. Harper, Peter Young, O. O. Thwing and Wm. Steinwedell.

The social part of the meeting will consist, on Friday, of a drive through the Park, arranged by the Committee of Arrangements. This cannot help but be interesting and instructive.

On Wednesday or Thursday evening a dance will be given at the Inn. Mr. Gibson will use every endeavor to make his guests comfortable, and all who attend will have every reason never to forget the nineteenth annual meeting of the Western Gas Association.

An invitation is extended to all members of kindred Associations to be present at our meeting and to participate in the proceedings.

The Question Box is ready to receive inquiries, and it is hoped many will avail themselves of the privilege it affords.

The President has appointed the following Committee of Arrangements: Messrs. Jas. Forbes, I. S. Post, Henry Clay Evans and T. H. Payne, of Chattanooga, Tenn.; Robt. Young, Knoxville, Tenn.; E. H. Jenkins, Covington, Ky.; and Jas. T. Lynn, Detroit, Mich.

The undersigned will be pleased to mail blank applications to any who may wish to join the Association and to reply to all communications concerning the meeting. JAMES W. DUNBAR, Secretary.

BRIEFLY TOLD.

THE MEETING OF THE TEXAS ASSOCIATION.—"Isag." forwards the following, dated the evening of the 12th inst.—Dear JOURNAL: The second annual meeting of the Texas Gas and Electric Light Association opened with a large attendance and a large list of new members. The day was fairly pleasant, although cloudy skies this afternoon were followed by some rain. The banquet to-night bids fair to be the event, in a social way, of the meeting. Everyone very much regrets the sickness of President W. E. Holmes, which was severe enough to prevent his attending the meeting. The most skeptical as to the success of the Association are now convinced that there was a place for a State Association in Texas, and that this one is filling it.

THE WESTERN'S WEEK.—If one may safely base a prediction on that which one has heard, the meeting of the Western Gas Association this week at Chattanooga will be a record maker, for we have heard it on all sides and for weeks that all roads leading to the meeting place are to be travelled by gas men anxious to share in the doings of the Western's nineteenth convention. We need hardly again say that all the preliminary arrangements have been made with care and foresight; in fact, nothing in the advance line has been left undone that should have been done. The main body of the visitors will reach Lookout Inn at a reasonably early hour of the evening preceding the first day's sessions, and all will be met by Manager Gibson, of the "Inn," in a way which will immediately show that he is a host in himself. A feature of the entertainment that will make a lasting impression will be the drive to and from the National Military Park, for the park and the drives abound in the grandest of scenery and teem with suggestions evoking memories of events that years ago stirred to quicker movement the pulse of the civilized world.

BOOKS RECEIVED.—The latest volume in Messrs. Spon & Chamberlain's "Series of Practical Handbooks" that we have received is on the "Care and Management of Gas Engines," which originally appeared in the German, from the pen of Herr G. Lieckfeld, C.E. The translation was made by Mr. G. Richmond, M.E., who has done his work well; but Messrs. Spon & Chamberlain have increased the usefulness of Herr Lieckfeld's treatise by adding thereto a chapter on oil engines. The book is just what it purports to be—not an abstruse dissertation, historical or otherwise, on gas engines in general, but a sensible compilation appealing directly to the *users* of gas for power purposes. The volume is well printed and serviceably bound, and the publishers' price for it is $1.

Another book, which comes to us through the courtesy of the D. Van Nostrand Company, of this city, is on the subject of electric lighting, and is the first of two volumes that were found necessary by the author for the complete treatment of his theme. The book before us is devoted to a clever outlining of the generating plant necessary to electric lighting, and the author (Francis B. Crocker, E.M., Ph.D.—he is also Professor of Electrical Engineering in Columbia University, and Vice President of the American Institute of Electrical Engineers) according to our idea has clearly and concisely accomplished the object he had in view. The type, illustrations and general mechanical get up of the volume are quite in accord with the practice in such respects of the Van Nostrand Company, who, we are informed, hope to speedily put upon the market the second or concluding volume of Prof. Crocker's work, which closing number will deal with that part of electric lighting relating to distributing conductors, lamps, special applications, etc. The price of the first volume is $3.

A third volume (it is really a pamphlet) is by Dr. Fritz Haber, of Karlsruhe, and published by Herr R. Oldenburg, of Munich, Germany. The title of the Doctor's compilation is "Experimental Investigations Concerning the Reduction and Burning of Hydrocarbons," and its matter is so instructive that we hope soon to know that a full translation into English of it has been made; for he has described in easily understandable way the successive steps taken by him and his assistants (the Messrs. G. Samoylowicz, H. Oechelhaeuser and A. Weber), at the suggestion of Prof. Bunte, who originated and materially forwarded this work (the book was printed as long ago as Nov. 28th last), in researches concerning the decomposition, synthesis, analysis and final results of the transpositions which the related hydrocarbons sustain when subjected to high temperatures. Dr. Haber remarks that although there have been numerous and valuable investigations of the subject for special purposes, still, notwithstanding the importance which these transpositions bear to the illuminating and oil gas industry, a systematically complete study seems not only not to be on record, but appears to have had comparatively little attention. Now that we remember it, our readers are not altogether unfamiliar with Dr. Haber's work; for, in our issue for March 16, p. 414, will be found a short abstract from it that will not fail to impress the thoughtful reader with the idea that the Doctor is original. In the course of his work he in fact overhauls theories which, although accepted as correct to date, he shows to be lacking in solid foundation. He describes the apparatus and methods employed by him in his analyses, wherefore the book is of use to the student as well as to the scholar.

MR. NELSON A. MCCLARY writes us that the Ogden gas works, of Chicago, will be constructed by the Western Republic Construction Company, Unity Building, 79 Dearborn street, Chicago, a corporation organized for the purpose. A site for the works has been secured north of North avenue, between the tracks of the Chicago, Milwaukee & St. Paul Railroad and the river. Plans and specifications are now being prepared and actual work will be commenced at an early date. Mr. McClary will be connected with the Construction Company as General Manager, having resigned his position as Secretary and General Manager of the National Gas and Water Company.

Elusive Leakages from Mains and Services.

[A paper read by Mr. H. Tobey, of Malton, before the North of England Gas Managers' Association.]

It has probably fallen to the lot of most managers of gas works to have been at some time much troubled and perplexed by leakages which have been difficult to trace to their source. Those who have had to track these "Will-o'-th'-Wisps" know full well how elusive they are. In relating my experience, I do so, not that it is so striking in itself, but that it may serve as a starting point from which others may recount theirs.

During one hard winter, a gentleman occupying a semi-detached villa, came to me complaining that his house stunk fearfully of gas, and that the gasfitter said it did not come from the fittings. Going to the house, I found the main tap turned off and the house reeking with gas. There was not much in the cellar where the service pipe and meter were, but it was most noticeable in the kitchen and scullery. Of course, immediate search was made, and the service pipe and the main immediately adjoining the premises were examined by means of a probing bar, but without any good result, as no leak could be found. The occupiers of the house were desperate at having to live with open windows during the inclement weather which prevailed at the time—there being some 8 inches of snow on the ground. Having failed to trace the escape to its source, it was determined as a means of giving temporary relief to open the drain pipe leading to the house—for the points at which the gas appeared to make its entry into the premises were the gullies on the scullery slopstone, and elsewhere. This had the desired effect of freeing the house of gas, and subsequent searches revealed a fractured 3-inch main some 160 yards away. The gas escaping from it had found its way into an adjoining sewer pipe and traveled up to the house. Although other houses were on the same sewer, they were unaffected, probably owing to their gullies being better trapped, or the sanitary arrangements of them being better arranged.

Some short time since I was requested by a neighboring gas company to investigate a nuisance said to arise from their working. The complaints were made by the occupier of a dwelling house, the back garden of which abutted on the gas works. At the time of my first visit I could detect no smell, though I was assured by the occupier that there had been at times an offensive one. Complaints had, it appeared, been previously made. A month or two passed away before I heard anything more of the nuisance. I was then informed that there was considerable complaint of gas leaking into the same premises, and not those only, but also into the adjoining premises, consisting of three shops and houses, one of which was unoccupied. On this occasion I found a very offensive smell in the occupied houses, but little or none in the empty house, which I may remark stood between the other houses. The smell, however, did not appear to me to be that of coal gas. It was more noisome—not of the same flavor, and seemed to have a phosphoric odor about it.

I applied Ansell's gas leakage indicator to those parts where the odor was strongest (which was the floor and skirting boards), but could get no movement of the pointer showing it was gas. I concluded it was not coal gas but sewer gas. To put it to the proof, I decided to try the drains with the smoke test. The drain upon which I commenced operations was one passing along the outside of a sitting room in which the offensive smell was very strong. It did not belong to that house, but to the unoccupied premises adjoining. The sitting room had a boarded floor, and was the only room on the ground floor which was boarded. There was no cellar beneath it. We opened out to the drain where it crossed the pavement in the street, and having cut a hole in the sanitary pipe for the nozzle of the connecting pipe, and inserted it, we lit the fire in the fumigator, and were about to commence blowing the smoke into the drain, when, *presto!* a piece of the drain pipe flew up into the air with a sharp report. This startled us, and caused me at once to alter my opinion as to the character of the gas.

The explosion was limited to that part of the drain pipe which had been broken into, where the air had mingled with the gas which was inside. The gas had traveled up the flexible connecting tube to the fire in the pan, and had there ignited. There was no doubt now it was coal gas. The smell as it oozed from the broken pipe was sufficient evidence of it. We made good the drain, and filled in; but we were still at a loss to know where the gas came from. The drain I concluded was connected to the main sewer running along the street, and as this sewer had manholes at short distances away on both sides, I proceeded to try the sewer by means of the leakage indicator, and expected to discover gas in it; but, somewhat to my disappointment, I found none.

I then decided to have the main gas pipe, which was on the opposite side of the street to the complaining houses, bared and examined. I had previously tried it along its length with an iron probing bar, without any gas being found. When the main was stripped, no leakage of any account was apparent. The next thing was to examine the services. The foreman went over them with the probing rod, and along the front of the houses, at short distances apart, and reported them to me as sound. The nuisance to the residents increased, and became so strong in the house first complained of that the occupiers removed. The mains and services being apparently sound, there arose considerable difference of opinion as to the origin of the nuisance. The Inspector of Nuisances gave it as his opinion that the subsoil was saturated with gas washings, and the Medical Officer of Health seemed to coincide with that view. Others thought there must be some old gas main, or a drain pipe which took a short cut underneath the premises from the gas works to the street, and had not been properly stopped off. I examined the pump wells at the backs of the houses, and found the water was not contaminated; neither did some subsoil water which collected in the cellar of the first house I inspected smell or taste of gas. I could get no information of any drainage or main ever having crossed the premises.

Having found gas in the drains, I fell back on an examination of them, and decided to disconnect a drain which led out of the cellar I have mentioned, into the main sewer. On opening out the ground in the street for this purpose, there was disclosed an old sewer, about 3 feet to 4 feet from the surface, with the existence of which I had not previously been made acquainted. A new and larger sewer had been put in at a lower depth, and this old one had been left in, but cut off at both ends. Breaking into it, it was found two-thirds full of black soil, and from it issued what was undoubtedly coal gas. The leakage indicator was applied, and quickly ran up to between 15 and 20 per cent. of gas. Having discovered so much, the next thing was to ascertain which end of the sewer the gas came from. It was, therefore, completely broken through, and each end clayed up, with a short piece of ¾-inch iron pipe passing through the clay, when the gas was found to be issuing from the south end. To further localize the point where the gas entered, it was again and again subdivided. By this means it was found that the section where the gas entered was in close proximity to one of the service pipes, and upon baring the pipe it was discovered that a joint had been drawn apart and the pipe forced down at the place where it crossed the trench of the new sewer. The injury to the pipe may have been caused by the passage over it of a traction engine or some heavily loaded vehicle.

The escaping gas appears to have made its way downwards through the gravelly strata to the old sewer, and then along the sewer and drain pipes, distributing itself through their open joints (for they were innocent of any jointing material—either mortar, cement or clay). It would also travel through the strata to the dwelling rooms, being drawn there by the suction of the fires. The asphalted paving, the metalling of the roadway, and the compact soil underneath it, would prevent it making its way upwards.

After this service pipe had been made good, the nuisances gradually died away. One of the occupants did subsequently complain that the nuisance continued, but by observing the testing pointer of his meter and examining his fittings, it was found to arise from a leaky pendant. Had the overhauling of the service pipes been more thoroughly done, the leakage would doubtless have been discovered earlier, and the nuisance abated sooner.

To search for escapes of gas in confined spaces with a light, is notoriously a foolish thing to do. Though a light may with safety be burning in a room where there is a strong smell of gas, an unwitting shifting of the light, either to the ceiling or the floor, may result in disaster. For there may be a dangerous admixture of gas and air underneath the floor boards—between them and the soil; while above the boards it is so diluted as to be harmless. In many instances it is desirable some other test than a light should be used. There are not many available. The sense of smell is one of the readiest, and a fairly good one, but not absolutely reliable. It is a faculty much more strongly developed in some individuals than others, and is liable to temporary derangement and total absence. The devices which are constructed for detecting the presence of gas—which are based upon the law of diffusion—appear to give fair indication in some cases, but not in all.

In the course of my investigations, I must say I was much surprised and disappointed at the conduct of the leakage indicator. With the rooms of houses more or less tainted with gas, it did not show its presence. I subsequently tried it with a leakage in the soil artificially made. An iron pipe about 26 inches long and 20 inches diameter was

planted in the soil on end, with the top level with the ground; and gas was led into the bottom of it by means of a ½-inch iron pipe. The soil in and around it was trodden down. After gas had been passing in for 15 hours, and 540 cubic feet had gone through, the leakage indicator did not indicate any percentage of gas, nor was there any smell of gas. After the lapse of 24 hours, when 800 cubic feet of gas had passed, the indicator showed from 2 to 3 per cent., and there was a faint smell. At the end of the first 15 hours, when a bar was forced down, and a channel made for the gas to flow freely up, the indicator answered to the gas at once—the pointer moving freely round. It would seem that, when gas percolates slowly through the soil, there is some active influence in it, which alters the character of the gas, and makes the indicator of no avail. In simple mixtures of gas and air, arising from leakage direct into the atmosphere, it answers well. These indicators are constructed to take advantage of the law of diffusion, namely, that the velocity of the diffusion of gases is inversely as the square roots of their densities. Thus four volumes of hydrogen will pass through a porous diaphragm in the same time as one volume of oxygen; oxygen being 16 times as heavy as hydrogen.

In the early part of 1886, some interesting investigations upon the loss of smell by gas in passing through soil, made by the German Society of Gas Engineers, were published in the *Journal of Gas Lighting*. The conclusions arrived at were that, though there might be an escape of coal gas through the soil which might not be odorous, it would not be considerable or dangerous; and that any escape before it became explosive or acutely harmful to individuals would be plainly apparent to persons whose olfactory organs were in a normal condition. Experiments were instituted to detect the presence of gas by other means than smell; and a chemical test was proposed, and apparently used with success, it being stated that the existence of gas could be recognised much sooner by it than by smell.

In adopting chemical means for proving the presence of gas, it was pointed out that there is no reaction known to exist exclusively in in the case of coal gas. It is only the carbonic oxide it contains which produces characteristic phenomena. The quantity of carbonic oxide in gas is of first importance for its recognition by chemical means. It is a never failing ingredient of gases resulting from the dry distillation of carbonaceous substances—as wood, peat, coke and coal. Coal gas contains quantities varying from 3 to 11 per cent. of it. Chloride of palladium is a chemical which has been found to give clear indications of the presence of carbonic oxide, it being capable of detecting the most minute quantities of it. In a solution of chloride of palladium, carbonic oxide separates metallic palladium, which can be recognized by the intense blackness, if carbonic oxide be in considerable quantity, and which discolors the liquid however small the amount of carbonic oxide may be. The paper goes on to say, since no gas but that used for lighting purposes has the same effect upon a solution of palladium (except dydrothionic acid, which is easily recognized), mistakes are impossible. The sense of smell may be defective, or the ordinary odor of gas may be modified or overpowered by the scent of other substances. The palladium test is free from those defects, which therefore gives it special value in discovering and distinguishing escapes of coal gas.

It was while pursuing my investigations into the complaints before referred to, that there appeared in the *Journal* for Feb. 5, 1895, a notice of apparatus designed to determine with accuracy and precision the presence and percentage of hydrocarbon vapors in any given atmosphere. Originally intended for testing the air in coal mines, it had been successively adopted for detecting inflammable vapors in the holds of ships engaged in transporting petroleum, and then for testing the air in the boxes and culverts of electric lighting distributing plants. The alarming and deplorable explosions which have occured in these boxes demanded that some accurate and reliable apparatus should be available for investigating the cause and preventing their recurrence. The apparatus designed by Mr. Boverton Redwood and Professor Clowes is so delicate in its application, that it will unfailingly indicate the presence of one-half of 1 per cent. of gas in the atmosphere. A sample of any suspected air can be taken in a collecting vessel, and removed for after-examination. I was not able to take advantage of this invention myself, as the price when the apparatus was first brought out was prohibitive. It did occur to me that the agents, or some other enterprising individuals, might send the collecting vessel to be charged, and afterwards test the contents for a reasonable fee, or that they might collect and test the sample themselves, charging therefor, and so obviate the necessity of small gas undertakings possessing themselves of an expensive apparatus which they might have only rare occasion to use.

I am glad to be able to-day by the kindness of the agents for the Redwood and Clowes gas detector, viz., the Gas Lighting Improvement Company, Limited, to show you the contrivance of the value and usefulness of which there can be no question, as I understand it is now in constant use for the detection of inflammable vapors in electric street boxes and channels. Mr. Hall, the Engineer to the Company, will kindly explain the *modus operandi* of the apparatus.

It must be nearly a quarter of a century ago, when—troubled with a complaint that the gas of a company I was then with was making itself noisome and offensive by getting into a dwelling house where no gas was laid on—I appealed to a gentleman high in the gas profession for some means whereby I might distinguish between coal gas and sewer gas, and was informed there was *none* other than the nose and sense of smell. Science in that domain, as in others, has now provided us with other resources.

Discussion.

Mr. T. Bower (West Hartlepool) said that some of the points raised by Mr. Tobey in his paper were, he might almost say, unique. There was one point in the first case he gave, which struck him as somewhat peculiar. It was towards the end of the second paragraph. Perhaps in West Hartlepool they lived in a modern town, but they found that if their gulley pipes were so arranged that gas could get through to the slop stone, they would be very much surprised at it. They had them so cut off that no gas, neither coal gas nor sewer gas, could get into the houses. It might, however, be very difficult to discover whether the gas coming into the house through the slop stone trap was coal gas or sewer gas. One of the first steps that he should take, if called upon to investigate a case of this kind, would be to cut off the slop stone pipe, and satisfy himself whether it was coal or sewer gas. He only mentioned this by the way, and no doubt Mr. Tobey would give the meeting some explanation whether the gas came straight through into the drain. In regard to the case which was illustrated on a drawing before them, there was no doubt that many escapes, and much trouble and expense, were occasioned by the leaving in the soil of old pipes. He did not refer solely to gas pipes or sewers, but to pipes of any description. He had found, from personal experience, that one of the very worst things they could do, when laying a new pipe, was to leave the old one down. Some people said it was not worth the trouble of taking out an old 4-inch pipe when laying a 6-inch one; but it seemed to him that it was their paramount duty to take out the old pipe. They did not know who was to follow them, and they ought to make it as easy as possible for those who were to succeed them to do their duty. While they were doing this they would be obviating such a difficulty as Mr. Tobey had mentioned to them. He was very much interested with the apparatus which had been shown to them, and he would like very much to hear something more about it. He had himself tested with this indicator, and if he were to give his opinion of it, he should say it was very small. It might possibly be that they manipulated it wrongly, but their experience at Hartlepool was that they did not get any satisfactory results from the apparatus. Especially was this so when the escape of gas was only slight. The greater the escape of gas was the better were the results from the detector. If any apparatus, such as that before them, could be proved to be effective in testing for leakages—either of coal gas or sewer gas, or in detecting between the two—then he thought it would be found to be very serviceable.

Mr. David Terrace (Middlesbrough) mentioned a circumstance which was perhaps unique in reference to elusive leakages. It happened about a year ago, in a street in Middlesbrough. There was a fractural main, and they found afterwards that the gas, instead of coming to the surface, on account of the frost, leaked into a drain. The peculiar thing was that it caught fire in the drain, although there was no possibility of light getting near it, as far as they could conceive. The only way they could detect it, was by the heat on the paving stones. This led to their digging down, when they found the fracture. Their experience did not lead them to understand how it was possible for an escape to take fire in a street drain, when there was no light in it. He did not know if there was a possibility of the gas taking fire itself. It was, perhaps, such a case as Mr. Tobey might have made use of, if he had known of it.

Mr. W. Ford (Stockton) said that a similar occurrence happened with him about two years ago, as that to which Mr. Terrace had referred. Unfortunately, it was a Corporation drain, which was a cost to themselves. It was nearly 300 yards away, and they had an explosion in the back premises of a cottage, without any light seeming to have been applied. But he differed from Mr. Terrace on the ques-

tion of the possibility of an explosion taking place without light. He questioned very much if coal gas, whether mixed with atmospheric air or not, could explode of itself. He should like very much that some of their scientific friends would clear the matter up. However, their man went into the back yard, thought he smelt gas, struck a light, and an explosion occurred instantly, and he was put on his back. Some of their friends in the northern portion of the district had very serious difficulties to contend with in regard to leakage. All their streets were made upon large pieces of slag; and these pieces of slag were put down by their road surveyors, he was sorry to say, without any idea of regularity. Then when a steam roller went over them, it very naturally broke the mains and service pipes. He had known escapes to be percolating through the ground before they could discover where the broken main was. He was sure that if anything could be made which would detect these gas leakages, and localize them, it would be a boon to Mr. Terrace and himself. He might say that now—with great care and attention displayed with reference to the condition of service pipes and mains, and by the use of the instrument shown by their friends—he had been enabled to reduce his leakage to 4 per cent., by which they were able to sell gas at 50 cents per 1000 cubic feet. They did not compete with South Shields or Newcastle, where gas was sold at 41 cents per 1000 cubic feet; but in reducing the leakage, they had been able to lower the price of gas to 50 cents.

Mr. J. Whyte (Seaham Harbor) felt particularly interested in the subject Mr. Tobey had brought forward, from the simple fact that his leakage was a very heavy one. If they could find means by which to reduce it, he should be very pleased indeed. Some few years ago he was called upon about an explosion of gas in a house, which did some considerable damage. When he went to the place, he said he did not think it had been coal gas. Gas was burning with a blue flame at the skirting board for about a yard and a half on each side of the fireplace. His men worked for two or three days, and they succeeded in getting the smell removed, and, as it was supposed, the leakage as well, though he, for his part, did not understand it, because they had done nothing, so far as he could see, that could have stopped a leak. But the fact was it was merely stopped in the meantime. In the course of a few weeks the smell was as bad as ever, and he spent pounds upon pounds in searching for the leak. He insisted that it was sewer gas; but, on the other side, they insisted that it was coal gas, and that they would sue the Gas Company. He offered to come to an arrangement whereby he would strip his mains, and if a leakage of coal gas were found he would pay all the expense, but failing that, he would charge the consumer for it. They would do nothing of the kind, as they said they had found the leakage. He was very pleased to hear it, but the smell was there still. In a few weeks it was found that it was sewer gas. The trouble was that when the wind blew from the east the house was all right, but when it blew from the west the nuisance was there. He had had considerable experience in these cases. It was a most destructive thing when gas got into a common sewer. He fancied that there was no possibility of telling the difference between sewer gas and coal gas after it had traveled a certain distance in the earth and got into a drain. He considered that they were sometimes blamed for coal gas leakages and explosions when, after all, it was not coal gas.

Mr. J. Hepworth (Edinburgh) said that no one in the room regarded this matter with more interest than he did, because, as had been already pointed out in the debate, what was wanted was an instrument which would indicate about correctly the nature of the gas which was found to be escaping. He was sorry to hear from Mr. Bower that his experience with the instrument before them was not altogether satisfactory. He hoped that this might be due to the fact that he was not in the habit of using the instrument every day, and that if he had had more experience with it the results might have been more correctly ascertained. He once had considerable difficulty in discerning the nature of a gas which was said to be escaping from a certain main. He was sorry to say that all the intelligence that could be brought to bear upon the matter from both sides—from the local surveyor, and any intelligence he could bring to bear upon it—did not absolutely clear it up at the time; neither had it been, perhaps, quite cleared up even to this day. Very serious interference had been brought about by the extension of the railway system; and there was no doubt that there was a very offensive smell finding its way into a valuable block of property. The sanitary department, of course, said it was coal gas; and the gas department, of course, said it was sewer gas. He believed that if he were to be accepted as judge in the case, he should have no hesitation in saying that it was pure sewer gas; and in fact, after certain things had been done to the drains, the result was the abolition of the long continued nuisance, which seemed to indicate that this was the source of it. But what would have been valuable at that time, and what would have saved all the dispute—which extended over a considerable period—and would have saved all the nuisance, which had lasted for a considerable time, would have been an instrument like that which had been introduced to them that day, which would have indicated the exact nature of the gas with which they had to deal. It was, of course, a friendly dispute; one believed that it was coal gas, and the other believed that it was sewer gas. The instrument now shown, he thought, would have told them exactly what it was. If this were within the power of the instrument, he could not conceive of anything more valuable than it would prove to be.

The President said the question of leakage was one which troubled them all more or less, and it was one which they were all anxious to see reduced to the lowest possible minimum. But it required very constant supervision if they were to attain good results. Fractured mains which perhaps were now more common since steam rollers of 10 or 15 tons weight were brought upon their roads, would account for not a few of the leaks which occurred; and especially in the case of old mains which were laid very shallow, they would have more fractures than if they had been laid deeper. The circumstance which had been detailed before them by Mr. Whyte brought to his mind an instance where a complaint had been made in a small village with which he had some connection, of an escape of gas. It had continued for several years. Efforts had been made to discover it; and, so far, no coal gas had been found. He thought he was in a position now to discover whether it was coal or sewer gas, because the whole of the mains in the neighborhood were about to be renewed. The experience of Mr. Whyte was so peculiar that he should be somewhat disposed to think that it was coal gas which was traveling a considerable distance, and getting its outlet there. They were all very much indebted to Mr. Tobey for bringing the subject before the meeting, and showing them the leakage indicator, which should be very valuable to them.

Mr. Tobey, in reply to Mr. Bower's remark about the drains, said that it was the fact that in some cases the drains were connected straight through to the slop stone. They were not all in such a good condition as regarded sanitary matters as they appeared to be in at Hartlepool. He knew that the proper thing was not to have a single drain in a house, but to have all outside; that was the course which was pursued in regard to all modern dwellings. But they must remember that there were some old buildings left. Mr. Terrace spoke of a case in which gas had fired in a drain. How this had occurred he could not possibly imagine. It appeared to him that spontaneous combustion could not possibly take place. It might, of course, arise in the event of some chemicals coming into contact with other chemicals, but they all knew that purified coal gas required a very high temperature to fire it. How the gas in Mr. Terrace's case became ignited, was, he thought, a problem which could not be solved. Mr. Whyte had spoken of an experience of his, in which the gas lit along the side of the walls, and burned with a blue flame; and he came to the conclusion that it was sewer gas. He (Mr. Tobey) should have come to the entirely opposite conclusion — that it was coal gas. To his mind, it was impossible for sewer gas to ignite. He did not think there were the elements for ignition in it. He did not see what properties there were in sewer gas which could ignite. Sewer gas was composed to a very large extent of carbonic acid. There was, of course, sulphureted hydrogen in it, but not in sufficient quantity to burn. It would be simply impossible, to his mind, for ordinary sewer gas to ignite. He thought there must have been an admixture of coal and sewer gas. He could quite see that there might have been some petroleum poured into the drain some distance away, and the vapor of this might have traveled along and burned. Mr. Hepworth had spoken of the value of the apparatus which they had before them. There was no doubt that it was a most valuable apparatus, and in cases of dispute—where one said it was coal gas and the other said, equally emphatically, that it was sewer gas—they might fall back upon an apparatus of the sort, and ascertain whether it was coal gas or not. It would be a very great advantage to have some test of this sort, so that they might say with "dead" certainty whether it was coal gas or an admixture of coal gas with any other gas with which they were dealing. There was the chloride of palladium test, which was described before the German Society of Gas Engineers. It appeared to be very good, and would possibly be of great value if they could follow out the test which they recommended. It was a test by a solution of chloride of palladium. He obtained a solution to try it, but it did not seem to answer to the description given in the paper—that was to say, a piece of paper which was exposed to coal gas did not blacken as was said. However, on turning up a book on chemistry, he saw that there were

two qualities of palladium, and it was very possible that he had the wrong one. He hoped to get the right one next time, and try it again.

Mr. Hall (representative of the manufacturers) then fully explained the action of the Redwood and Clowes gas detector, and illustrated its working. The apparatus was in two forms—a large and a small, the latter (mounted on a tripod) being used for the detection of gas in electric light culverts.

Interesting Comment on the Massachusetts Pipe Line Company Bill.

The following matter will be worth reading in connection with the proposed chartering of the Massachusetts Pipe Line Company, by the Massachusetts Legislature. The text of the bill will be found in the JOURNAL for May 11, p. 734.

This bill omits some of the objectionable features of the bill originally presented to the Committee, while others equally objectionable are retained in it. The radical and insuperable objection to the new bill, as to the former, is that it exposes every dollar of the $27,000,000 of capital now invested in the gas business in Massachusetts to disastrous competition, without a particle of the protection or security established by the Legislature in the Gas Commission Act of 1885, or the Municipal Lighting Act of 1891. In this respect it is even more dangerous and destructive than the original bill. *Nothing approaching so nearly to absolute confiscation of millions of property was ever enacted by the Massachusetts Legislature.*

Section 1 of the new bill is still open to the objection, equally with the original bill, that the supply of gas for "heating, cooking, chemical, mechanical and power purposes" has never been held a public service, such as to support the right of eminent domain (which this bill contains, in a form as sweeping and extensive as the original, namely, all over the Commonwealth), and it is entirely probable that a grant of eminent domain for the supply of gas for *power*, a mere business use, and not in any view a public use, is unconstitutional.

Section 1 contains also the very objectionable clause permitting the Company to do anything or nothing, as they please and when they please, subject only to the trivial conditions of Sections 9 and 12; a total departure from the principles and policy which govern all public franchises in Massachusetts. This clause should be stricken out, and the Company thereby put on the same footing with all other public service corporations in this respect.

Section 3 does not wholly meet the stock watering objections to the original bill.

The issue of capital stock and bonds should be made subject to all the legal restrictions applicable to the stock or bonds of other gas companies. This section does not make them so, and needs amendment for that purpose. (See Public Statutes, ch. 106, sec. 39-41; St. 1894, 450, 492.)

This section also provides that the Company may commence business when but 10 per cent. of the capital is paid in. Other gas companies, and corporations generally, are required to pay in their whole capital before commencing business. (Pub. Statutes, ch. 105, secs. 17-19; ch. 106, secs. 46-48.) This Company should be put upon the footing of the other companies in this respect.

It may and probably will be claimed also that the permission to commence business with but 10 per cent. of the capital paid in, exempts the Company from the restriction of the general laws as to the issue of stock. If this is so, $5,000,000 of stock can go upon the market on payment of $500,000 of capital, and the Company is at one stroke made a gigantic stock watering machine.

The clause at the end of this section exempting the officers and stockholders from personal liability, "except as provided in sec. 46 of chap. 106," should be stricken out. It is not needed to protect them against anything which they are expressly authorized to do by the bill, and they should not be exempted from liability for anything else. In other words, they should be put upon the same footing with the officers and stockholders of other gas companies in respect of personal liability.

Section 4 gives a practically unrestricted right (as will be seen by sec. 5) to lay pipe lines anywhere and everywhere throughout the Commonwealth, in all highways and all other public and private lands. Nothing of this kind was ever conferred on a gas company or any other Massachusetts corporation. In order to put this Company on the footing of other gas companies in this respect, this section should be amended by making the Company subject to the laws applicable to the laying of pipes by gas companies, or at least the Board of Gas Commissioners should be given some power of regulation or control over the locations.

Section 5 is one of the most deceptive and dangerous sections of the bill. It is so drawn as to appear to give the local authorities, or the Board of Gas Commissioners on appeal, a power of control over the locations of this Company. In fact it gives no such thing. The Aldermen or Selectmen (line 9) "*shall* grant" some location, and if they refuse, or grant an unsatisfactory location the Board (lines 16, 17) "*shall* grant" a location. The only power of the local authorities or the Board is to determine *where* the pipes shall be laid. They cannot in any case prevent or control the laying of them, and so the Company is absolutely entitled to a location, or apparently to as many locations as it chooses, in any and every city or town. As these provisions give the Company an enormous and unnecessary advantage over all other companies, and enable it to become a great and dangerous monopoly, they should be stricken out.

Another noticeable feature of this section is in lines 22, 23, "the location granted shall become *absolute*." This was doubtless designed, and is probably sufficient, to make the locations of this Company *permanent*, while the locations of the other gas companies are revocable. Of course this should be stricken out.

Section 6 gives an unrestricted right of eminent domain in lands throughout the Commonwealth. No such power was ever found necessary or was ever conferred on a gas company in Massachusetts. This provision, if it is to stand, furnishes an additional reason for requiring the whole capital to be paid in, in order that there may be adequate security for damages for lands taken.

The power given by Sec. 7 to purchase, lease or operate the works of any other person or corporation, etc., "engaged in the business of selling or distributing gas, *or any portion* of such works," applies to the combination companies which furnish both gas and electric light, and permits the purchase, lease or operation of the gas plant (but not the electric plant—see Sec. 11, lines 6, 8) of such companies.

But this Section cunningly provides, as to the price of gas furnished by the Company, only that it shall not exceed "the prices ruling at the time of such purchase," etc. This means, of course, the prices ruling *there*, that is, the price then charged by the purchased company. This takes the price which may be charged by the Whitney Company out of the restrictions of Sec. 10, which apply only to "the following cases" (Sec. 10, line 2), while the provision of Sec. 7 is a special provision for a special case. As the bill stands, therefore, consumers in a city or town where the Whitney Company acquires the local plant, have no assurance of the prices fixed by Sec. 10, or of any reduction whatever in price. This provision of Sec. 7, for the protection of the public at least, should be amended so as to provide that the price in such cases shall not exceed the prices limited by Sec. 10.

Both of these Sections, 7 and 8, are in effect, all on one side, and that the Whitney Company's side. They are at liberty to force any local company into a sale, lease, operating contract or contract for the purchase of gas, under threats of competition, etc., but no other company and no city or town has, under any circumstances, any right or power to require or compel the Whitney Company to buy, lease or operate its works at any price, or even to supply it with gas.

Section 9, lines 1–10, permits the Company to supply *fuel* gas in any city or town without regard to the existence of a local gas company. By Sec. 1, lines 15–21, "fuel gas" is gas of any degree of illuminating power intended to be used for heating and mechanical purposes, *but also for illuminating purposes*, by means of the Welsbach or any similar device. The Company can therefore compete to this extent with the local company in supplying gas for *illumination*, without any restraint or condition whatever.

By this section, lines 10–17, it may also supply true illuminating gas (which by Sec. 1, lines 11–14, is gas of the required standard of purity and power) without any conditions, in any city or town having no gas company.

By this section, lines 17–44, it may supply true illuminating gas in any city or town, in competition with the local company, on filing with the Board a stipulation as to price, unless the local company thereupon binds itself to the Board to supply gas at the price offered by the Whitney Company, which cannot thereafter be increased.

Every gas company in Massachusetts is therefore exposed at once to the competition of the Whitney Company in fuel gas, which may be used for light, and to full competition in illuminating gas unless it binds itself for all time to any price at which the Whitney Company, with the advantage of its franchise and greater capital, will offer to sell gas *in that city or town.*

To make it certain that the Whitney Company shall have ample time and opportunity to drive the local company out of the field, without undue risk or expense to itself, it may renew its application as soon

and as often as it likes, if the local company is not driven to surrender by the first application (lines 42-44), and when the application succeeds it can hold the field against the local company for two full years if it lays a single pipe within six months, and supplies a single consumer within 18 months thereafter. During this periad of two years the local company remains under the cloud of approaching competition at a price which it cannot afford to meet, while the general public has no assurance of any benefit whatever.

The scheme obviously is to utilize this period of two years to compel the surrender and sale or lease of the local company, on the reasonable assumption that if they are not sufficiently frightened at the outset, they will be when they have reflected on their situation.

A more effective device for destroying the existing companies, or compelling them to sell out to the Whitney Company, cannot be easily conceived. It is practical confiscation of the property of the existing companies.

This entire section should be stricken from the bill, and a section substituted giving the existing companies the protection afforded by the Municipal Lighting Act of 1891.

This section makes the bill worse for the gas companies than the original bill, in the vital point ot competition in their own territory. Under the original bill, the Whitney Company could not enter the city or town of an existing company without at least a two-thirds vote of the people. This single chance of life is now taken from the existing companies, and the Whitney Company may enter their cities and towns without any restraint for the supply of fuel gas, for *lighting* as well as for other purposes, and may enter them for all purposes by simply naming a price *for that city or town* which the local company cannot meet. The field then belongs to the Whitney Company, and the local company must go out of business, with no sale even of its plant.

Section 10 is of the same illusive and deceptive character as Sec. 8 of the original bill. It is designed to convey the idea of 35 cent gas, while the fact is that no price *to the consumer* is fixed or limited by it, and the public has no assurance that they will get a foot of gas under it at any material reduction from the present price. Yet the whole of the promised public benefit, if any, is in this section.

Even if this section contained any assurance of any present public benefit, which it does not, it would be folly to tie the people of Massachusetts to any fixed price for gas for the next 20 years, as this bill does. The Company should be made subject to the regulation of the Board in respect of prices, as the other Companies are, so that prices may follow the advance of science and the progress of the art.

In line 15 of this section the Company is allowed to charge "the legal rate" of interest on the cost of the distributing system—which means 6 per cent. Five per cent. is ample, and is as much as the Company should be allowed to charge against consumers.

In section 11 the first clause exempts the Company from the compulsory supply law of 1886, as to fuel gas. This applies to the supply of fuel as well as illuminating gas by any other Company, and it should be applied to this Company, not only for the sake of equal rights, but to furnish the public with proper assurance of the promised benefits of fuel gas.

In section 12 the security required for the performance of the franchise is wholly insufficient and practically valueless. If the Company lays 25 miles of pipe, of any size, in any place within three years, or within such further time as this period may be extended by litigation, it holds all its franchises and privileges absolutely for the full term of 20 years, beyond the reach of legislative or judicial interference. The number of people who could benefit by this 25-mile line would be trifling in comparison with the whole people of Massachusetts to whom the bait is offered, but this is enough to hold the franchise and to keep the menace hanging over all the other gas companies.

The provision for compelling the Treasurer of the Commonwealth to issue a certificate of compliance with the conditions, is unusual, unnecessary and objectionable, and is a specimen of the special and peculiar privileges which this Company claims and is likely to get if measures are not taken to prevent it. The conditions should be made substantial, so as to be of some value to the public, and the Company be left, as all other companies are, to comply with them at the risk of forfeiture of its charter.

The bill furnishes no assurance of any public benefit, but on the other hand it endows this Company with a variety of extraordinary powers and privileges, and binds the people for 20 years to the prices named by the Company itself. Such a bill, in any form into which it can be put, is preposterous. In its present form, or anything resembling it, it is outrageous. In any form in which its promoters would be willing to take it, it would be a standing menace to every other gas company in Massachusetts. It ought to be defeated, and the managers of the gas companies can only discharge their duty to their stockholders, and the members of the Legislature to their constituents and the public, by exposing its true character and dealing with it accordingly.

Gas vs. Electricity as an Investment for Towns.

[A paper read before the Eastern Counties Gas Managers' Association, by Mr. J. H. Troughton, of the Newmarket (England) Gas Company.]

It recently occurred to me, after I had received several disappointing letters from our members declining to read a paper or get up a discussion, that I might give you a few figures relating to the growth of the Newmarket Gas Company, and its relation to the town as an investment, with the view of raising a discussion. Briefly, I may say that we are threatened with the electric light—first, by a private Company who gave notice to the Board of Trade last October of their intention to apply for a Provisional Order; and secondly, by the Local Authority, who have decided to oppose the Company, because in years gone by the authority missed acquiring the gas works and water works, which have turned out such good investments. Consequently, they made up their minds to apply for a Provisional Order, so as not to miss any more good things, and they will do so, I presume, next autumn. This opposition has, of course, stopped the Company.

In passing, I may say that our Town Surveyor estimates that an electric installation costing $50,000 can be put down in Newmarket, and worked at a profit of $3,000 a year. That 6 per cent. will be very nice when they have made it, but we hear of so many electric concerns that earn nothing at all, and so few that earn 6 per cent., that we may be excused for being somewhat dubious. I know several large towns which are supplying electricity at a loss.

The point I want to bring before you is that a gas company in a small or medium-sized town, with a growing business, is a better investment to the consumers of gas, who are the ratepayers, than is an installation of electric light, whether it be supplied by a company or by the local authority. We make and sell four times the quantity of gas that we did 20 years ago, and we are selling it at 50 cents per 1000 cubic feet less than we were then. I will give you a short statement of the growth—

In 1875–6 we made	11¼	millions, and sold it at	$1.45	per 1000 feet.
" 1879–80	"	17¾	"	"	$1.25	"
" 1883–4	"	22¾	"	"	$1.12	"
" 1889–90	"	36½	"	"	$1.04	"
" 1894–5	"	46½	"	"	.95	"

This reduction in price is entirely due to the expansion of the Company's business. The difference between $1.45 and 95 cents means that on our last year's sale of gas over $21,000 per annum was given back to the consumer by way of a reduced gas bill, and this sum will go on increasing with the Company's business. Besides this, we have paid dividends for several years of 10, 11 and 12 per cent.; and the last dividend was at the rate of 12½ per cent. upon all our capital.

Last year we obtained a special Act of Parliament with the sliding scale and auction clauses inserted, which provides that all new capital shall be sold by auction or tender; and we expect to raise the $75,000 of new capital authorized at about 4 per cent., and the $75,000 of loan capital authorized at 3½ per cent. We are at present offering $25,000 of debenture stock at 3½ per cent., and this money will be expended on extensions as the demand arises. You will thus notice that we have power to raise $150,000, which we expect to get at from 3½ to 3¾ per cent., instead of allotting it among existing shareholders, at par as formerly, and paying the usual 10 or 11 per cent. dividend upon it. There is a great saving here, and it affects the consumers of gas very considerably. If this capital is properly laid out on extensions, it should (and I think it will) earn 12 or 13 per cent. After paying the interest on it 9 per cent. will remain, which on the whole of the new capital will amount to $13,500. That will be apportioned under the sliding scale as follows: 73 per cent., or $9,820 of this sum will go annually into the gas consumers' pockets instead of into those of the shareholders as formerly; and only the remaining 27 per cent., or $3,680 will go to the original proprietors. I think this gives the consumers of gas a large interest in future extensions and developments of the Gas Company, which to a very great extent is carried on for their benefit, so far as future business is concerned; and the consumers are the general public, for, with the aid of the slot meter, we shall soon have every one using gas.

I think a town that has quadrupled its make of gas in 20 years, and

reduced the price 50 cents, may reasonably be expected to double again in 15 years, and at our present rate of growth we estimate that we shall do so. Assuming that we do, and are selling, in round numbers, 100 million cubic feet (which I do not think is an extravagant estimate), we ought, owing to the growth of the business, the benefit we shall have from cheaper capital, and the economies in production that follow growth, to be selling gas at 62½ cents per 1000 cubic feet. This on a sale of 100 million cubic feet would mean the enormous sum of $33,330 being returned annually to the consumers of gas in the shape of reduced bills. That is, of course, looking ahead some 15 years, but I will come nearer home. That large sum of money will be given back to the consumers by degrees; they will not have to wait 15 years. Supposing we are enabled next year to reduce our selling price by 8 cents on a sale of 46 millions, the consumers would get $4,000 in reduced gas bills. So you see the public have the prospect of getting almost immediately a further reduction of $4,000 per annum, or more than our Surveyor estimates he can earn from the electric light.

But supposing the electric light comes in and prevents us extending our business as we are doing at present, it may have the effect of keeping the price of gas at its present figure, and instead of the Gas Company giving to the town a reduction equal to $4,000 per annum, the town itself will be the cause of the loss. But it might go beyond simply keeping the price of gas at its present figure. It might have the effect of causing it to be increased, for a Company selling gas under the sliding scale may increase their price. Substantial reductions can be made in the price of gas only where is a growing and increasing business. I do not, however, wish you to infer that there should be no electric light in our towns, because I think there is plenty of room for both illuminants in many. But in our small towns—in the Eastern Counties, for instance—I think figures such as those I have given should be laid before the public before they are "rushed" into a heavy expenditure to supply the electric light. We can all work out these facts as they apply to our own towns; and they should be forced home to the consumers and ratepayers when they are tempted with a glowing electric lighting scheme, for it can generally be proved that they have already a far better source of income in the gas works than can be offered by electricity. Besides, the electric light may not pay even in the hands of the local authority, but, on the contrary, money be lost, which would have to be made up out of the rates; and the poor ratepayer would have to pay his quota to maintain a light which at present can only be termed a luxury for the well-to-do. Thus the many may have to help to keep the electric light going for the few. I know several of our members have questions relating on this subject before them at the present time, and if they will discuss them and give us their experience, I shall be glad that I brought the matter before you to-day.

In conclusion, I think that, with such a large interest in the local gas works as the public undoubtedly have in nearly every town, they should be slow to embark on a new enterprise which, as we all know, so seldom pays its way, and which on the other hand, may prevent the gas company from conferring such large benefits on the town as I hope I have shown can be, and generally are, conferred, by a growing gas concern, whether it be in the hands of a corporation or a company.

Discussion.

Mr. J. Dixon (North Walsham) remarked that in the town which he represented they were threatened with the electric light. The question had been discussed by the District Council, but in that body they had not one practical member who understood anything about the subject. It was curious to notice how as soon as this question of electric lighting came before local authorities, the members at once seemed to know all about it. One member on their Council who was a crockery dealer stood up and said that, in his opinion, the electric light was cheaper than gas; but he gave no statistics in support of his statement. Another member (a draper) dilated upon the beauties of the light; and, indeed, from all that was said, it seemed that at North Walsham, they were going to have electricity for nothing. Being a member of the District Council, and the Secretary and Manager of the Gas Company, he made certain inquiries, and on mentioning the matter to a friend, he told him of Cowpen, where the electric light had been adopted, and had proved a failure. He (Mr. Dixon) wrote to the Chairman of the Blyth and Cowpen Gas Company for some information on the subject, and he replied in this way:

"I must first explain to you that our town is composed of two townships—namely, Blyth and Cowpen—each having a separate District Council. The Blyth Council have never used anything but gas in their district. The Cowpen Council and Gas Company could not come to terms. Hence the adoption of electricity, which was used for six years and has now been abandoned, the Council having agreed to burn gas on the same terms as Blyth. The reason why electricity has been given up was brought about on account of the great expense of Cowpen lighting, in comparison with Blyth, and also because, while the back streets of Blyth had lamps, the back streets of Cowpen were in darkness. The public dissatisfaction showed itself by the election of new members on the Council, who went in for gas. If you want more information from what would be considered a neutral party, you might apply to the Clerk to the Cowpen Urban Council."

Acting upon this suggestion, he addressed the Clerk of the District Council, who answered as follows:

"The lighting area within the district of the Council was, for a period of six or seven years prior to the 15th of May last, lighted by electricity, but it was an utter failure. The system of lighting was by overhead wires, the lamps being fixed in such a position in the main thoroughfares as was thought would light up the various back streets in the district. This it did not do; and during the whole time the electric lighting was in existence one-half of the district was not lighted at all. The Council have now returned to gas; and for a small district like this the system of lighting by gas is much cheaper. Prior to returning to gas the Council invited tenders for the lighting of the district by electricity, and they found that it would cost from $30,000 to $40,000 to lay down a proper installation. This was found to be so expensive that they eventually decided to return to gas. Taking the whole matter into consideration, I have no hesitation in stating that, for a small town, gas is the cheaper mode of public lighting."

The publication of these letters in the papers circulating in North Walsham gave, said Mr. Dixon, much annoyance to the advocates of electric lighting. When he became Secretary of the Gas Company, some 10 or 12 years ago, the price of gas was $1.35, and it had been reduced to $1.04. The system the Company had followed had been to reduce the price as soon as they possibly could after raising the dividend; and they had met the consumers (of whom they now had 150) in every way. For the public lighting they received $700 from the town, including lighting, extinguishing and cleaning. The argument for the electric light was that, if it was taken up, this $700 would pay for everything. Now, in small towns like North Walsham there was not room for two lighting companies—the one would spoil the other; and people seemed to overlook the fact that if the consumption of gas increased, the Gas Company could, without additional labor, supply at a cheaper rate. The price of $1.04 at North Walsham, he thought, would compare favorably with other places of an equal size. He did not know what the charge was at Dereham.

The President—We have two prices—75 cents for cooking and $1.12 for lighting.

Mr. Dixon proceeded to refer to other information he had collected during his investigations, and stated that he could not (with the exception of Thetford) find any place like North Walsham that was supplied with electricity at a cheaper rate than gas.

Mr. E. G. Smithard (Kings Lynn), speaking of the "high" dividends electric lighting companies were supposed to be going to make, said he saw in the *Journal of Gas Lighting* that the Belfast Corporation had made a profit of $1,925 during the past year, not allowing anything for interest or sinking fund, and that the gas works had provided all that was necessary in that respect. As most of the members were aware, he was formerly at Chelmsford, where they had a little electric lighting. As Mr. Troughton had put it, there was not room in a small town like that (where the gas company's make was between 30 and 40 millions) for both electricity and gas. At Chelmsford it affected their consumption something like 8 millions. They made at one time a maximum of 40 million cubic feet, and now it was 32 millions; the consequence being that the dividends were also affected. They would find it was so in all little places where they were running the two lights together—they would both be affected. He did not think there was any electric lighting works outside London that were paying dividends. As to the comparative prices of gas and electricity, of course everything turned on the course of the electricity. In the paper read by Mr. Tew at the Belfast meeting of The Gas Institute in 1893, he stated that electricity could not be manufactured for less than 10 cents per unit. This figure, light for light, would compare with gas at $1.04 per 1000 cubic feet—taking a unit as being equal to 100 cubic feet.

Mr. Dixon remarked that he inquired of the Incandescent Gas Light Company as to how to calculate the difference between the cost of gas and electricity, and they put it in this way: Take the price of $1.04, at which they were selling gas at North Walsham, the supply of 5 cubic feet per hour for 1000 hours would come to about $5, whereas electricity, at 12 cents per unit, would work out (roughly speaking) to $7.50.

Mr. Smithard added, as to the cost of public lighting at Chelmsford, that the Gas Company's tender (which was not accepted) was, he believed, for $3,250, while last year something like $5,000 was paid for lighting by electricity. He was not prepared to say that there was not more lighting, but there was not sufficient to account for the difference. He understood that the tender accepted for electric lighting was for about $4,250.

Mr. J. Barton (Peterborough) asked to be allowed to make a few remarks as to street incandescent gas lighting. At the last meeting, he said, they had a little discussion on that subject, and since then he had been making some experiments with the light in clusters of three. As he stated at the previous meeting, up to that time, the lights he had tried had been a failure. He had, however, altered the lamps; and he was pleased to state that he had obtained much better results—he thought he might say they were pretty well perfect. The illumination from the incandescent lamps in the streets was certainly quite as brilliant as the incandescent lighting in the shop windows. This had been accomplished in this way: He had altered the 60-candle power lamps by taking out the glass (or solid) bottom and substituting a perforated zinc plate; and this seemed to get over the difficulty. The incandescent light, in clusters of three (a single one was the same), required a greater supply of air than an ordinary gas flame. The 60-candle power lamp consumed, say, 15 cubic feet of gas in the ordinary way, while the 180-power incandescent gas lamp consumed practically 12 cubic feet of gas; but this 12 cubic feet required more air than the 15 feet. As to the cost of electricity compared with gas, he found that an electric lamp giving 10 candle power, compared with gas at 93 cents per 1,000 cubic feet, costs 2-5th cents per hour; but an incandescent gas lamp costing the same gave them 80 candles, or 8 times as much light. That was the difference between the cost of electricity as given by electricians and the cost of incandescent street lighting.

Mr. R. J. Sharman (Wisbech) said that at the last meeting he rather ridiculed incandescent gas lamps for street lighting; but since then he had been induced to try the light again. He had had a lamp introduced to his notice that was particularly adapted for the incandescent light, and he had tried one, as the cluster light had proved a failure in the old lamp. He placed it in one of the worst possible positions he could find, where it would catch the wind from all quarters. It was put up in November; but after a fortnight some misfortune occurred to the mantle, and it went to pieces. A new mantle was fixed, and from the end of November to the previous Sunday night, the lamp had never, to his knowledge, been out or touched. It was blown out on Sunday night, and he himself went to relight it. It struck him that the lamp was not particularly dirty, though, of course, a cleaning would improve it. He believed the Corporation were now advocating incandescent gas lighting, and the Company were prepared to fix the lights for them if they desired it. But the great point was whether they could adapt the present lamps, or would go in for a special lamp. The lamp he had tried had certainly so far proved a success. As to the electric light, he did not think they, as gas managers, ought particularly to set up their backs against it, seeing that the introduction of the electric light gave them an impetus to improve gas lighting in order to compete with it. He thought there would be room for both systems of lighting. If towns liked to spend their money in electric lighting, let them do so; they would gain experience by paying for it. There was no doubt, when electric lighting was introduced, it woke gas companies up and put them on their mettle, and had led to a considerable reduction in the price of gas. The first duty of a gas manager was undoubtedly to the shareholders; but, at the same time, he ought to study the consumer, and produce gas at the least possible cost.

Mr. R. G. Shadbolt (Grantham) drew attention to the fact that the discussion had departed from the topic introduced by Mr. Troughton, which was something to this effect: Is electric lighting an equally good investment to gas? So far as he could see, he did not think it was. But gas managers were interested parties; and people did not take much notice of what they had to say on this subject. The only time at which they could object at all was when the local authority proposed to spend an amount of money as they would think wastefully; and then they could protest as large ratepayers. With this exception he thought the best thing for them to do was to give electricity a fair field and no favor, and to meet it with truthful statements. He, as a gas engineer, could not help complaining of the untruthful statements electricians disseminated—it might be from over-enthusiasm or indiscretion, or it might be that they did not understand the subject thoroughly. (Laughter.) He thought the attention of electricians and that of the public ought to be drawn to this. He knew of cases where the public were actually gulled simply because they did not understand the subject. As to the adaptability of incandescent gas lights for street purposes, he might say that they had been experimenting with them at Grantham during the past winter. They had been guilty of not altogether adhering to the Welsbach lights, and they had tried a variety of kinds—whether rightly or wrongly remained to be seen. They put up about 30 burners in groups of four, three, one double and the remainder single; and in each case they took the lamp heads as they found them. His experience differed somewhat from that of Mr. Barton. Instead of increasing the air supply they had to reduce it. Some of the bottoms of the lamp heads were completely open, and the tops too. They found it advisable to check the air inlet at the bottom, to prevent any flickering, or sudden gusts of wind entering the lamp. The greatest importance, however, attached to the top of the lamp-head, as they found the down draught did more damage than the up draught. They checked this by putting in a little cone of perforated copper, or by surrounding the ordinary ventilator by copper or other equivalent according to the shape or size of the lamp. Out of the whole of the 30 burners they had not had a single failure. They had been able to adapt the whole of the lamp heads, and the experiment had been an unqualified success.

Mr. C. Ellis, referring to the electric lighting undertaking at Yarmouth, said the Gas Company had found it a rival, but still they had been making headway against it; last year something considerably more than the year previous. As far as the street lighting was concerned, he did not know whether or not the Corporation had had sufficient of it, but since they had started the electric works the Gas Company had come to terms with them to light by incandescent lamps, for three years, the principal streets not illuminated by means of electricity. The arrangement was based on the consumption of ordinary street lamps (5 cubic feet per hour), and they had something like 120 of the incandescent lamps in use. These had been running for about twelve months, and he did not think the Corporation would be in a hurry to extend their arc lighting. The incandescent lamps were working very well indeed. They found it necessary to check the upward current of air, and by means of an ordinary leather collar over the copper tube they prevented the wholesale destruction of the mantles, which now averaged per lamp about four per annum.

Mr. Troughton in the course of his reply, said he was pleased to hear Mr. Dixon give such an interesting account of Cowpen, as he happened to know that this place had been held up by parties advocating electric lighting as an example of prosperity. With regard to cheaper gas, that was one of the facts he wanted to press home in the short paper he had read. He thought it was of great importance to show the consumers and the ratepayers generally, that, by sticking to gas they would be helping to bring down the price. They could not go about preaching continually. But, as one speaker had mentioned, gas companies were large ratepayers, and when they were threatened with the electric light by the local authorities, then was the time to educate the ratepayers. The reports made by the electricians were too glowing; at any rate, when looked at from the gas manager's point of view, and the public required enlightening as to the advantages that were to be derived from gas, in order that they might make a fair, unbiased comparison between the two systems. With reference to the statement made by Mr. Dixon as to Thetford, the electric lighting plant there, he believed, was originally put down for lighting the works of Messrs. Burl; and the installation was found to be of sufficient capacity for a few outside customers. It was not therefore fair to take Thetford as a town that was lighted by electricity.

Mr. C. Snelling (Thetford) intervened with the remark that one of the largest customers had returned to gas, and was now using the incandescent light. He also mentioned that the gas company had lost the lighting of the Great Eastern Railway Station, and that the price of gas was $1.25 per 1,000 cubic feet for lighting, and $1.12 for cooking purposes.

Mr. Troughton (resuming) referred to Mr. Smithard's remarks as to the electric lighting of Chelmsford. He pointed out that the light was supplied by a large local firm of electrical engineers (Messrs. Crompton), and said, if they could supply it cheaply anywhere, they would do so at home for an advertisement. Still, as Mr. Smithard had shown, the townspeople were foolish enough to pay considerably more for the light than they would have to do for gas.

Mr. Ellis—Recently the accounts of the Yarmouth Corporation Electricity Department showed a balance of $3,950 on the wrong side.

Mr. Smithard, replying to an inquiry as to the financial results of electric lighting at Chelmsford, said there was an admitted loss, but its extent was not publicly known.

Mr. Troughton (continuing) pointed to the results of the working of the Worcester Electricity Department, as already recorded in the *Jour-*

nal, and also alluded to the fact that there were dividend paying electric lighting companies, but they all occupied specially favored districts, with numerous consumers on a short line of cable. But if a company started in a small town such as East Dereham, where the residents were far apart, it would cost a considerable sum of money to lay down the cables, and there would be a large proportion of leakage. He believed the leakage at Worcester last year was 25 per cent. of the electricity generated. He was glad Mr. Barton had given them a few useful figures relating to the incandescent light, because that at the present time was a strong competitor of the electric light. Mr. Sharman had expressed the opinion that there was room for both gas and the electric light. Seeing, however, that, if there was a loss on the latter, the ratepayers had to "pay the piper," his (Mr. Troughton's) view was that, if they could prevent the light coming into the small towns they represented in the Eastern Counties, they would be doing the rate payers a great kindness.

Concerning Foundations for Heavy Buildings.

[A paper read by Mr. Chas. Sooysmith, C.E., before the Am. Soc. C. E.]

As an introduction to what follows, it would seem well to describe briefly the chief conditions met under the surface in the parts of New York City where the high buildings recently constructed and proposed are situated. To this end a map of the city below 23d street is given (omitted here), which shows the principal topographical features of that territory before it was built upon. The made land near the shore line is generally from one to two blocks in width. Broad street to above Exchange place, and Maiden lane to Nassau street, occupy what were formerly inlets from the East river, and there were ponds east and north of City Hall Square. There seems to have been a natural waterway practically all the way from the North river, following about the line of Canal street and into Collect pond, and from thence to the East river near Chambers street. Notice should be taken also of the location of Minetta stream, which was formed near the present junction of 11th street and 6th avenue. This stream flowed through what is now Washington Square and into the Hudson a little below Houston street. The lines indicating elevations must not be allowed to mislead; in many cases the comparatively elevated portions are land made by the processes of Nature in comparatively recent times, it being rather the exception in the lower part of the island to find other than a drifted or deposited material within the distance below the surface at which the foundations of buildings are usually built. This upper material is mud, silt, sand, usually from fine to very fine, and sometimes gravel. The hard stratum below it, where not rock, is generally an exceedingly firm and compact surface of silt, clay and gravel, containing stones of various sizes, which is generally called hardpan. This is so hard that, in reports on the borings taken to ascertain the nature of the underground material about the city, it has generally been referred to as rock. The so called bedrock in the profile prepared for the proposed tunnel road in Broadway, is this material—in all probability in lower Broadway. In its natural condition in places it is so hard that for all the weights that can come on it through the construction of buildings it may be considered absolutely unyielding. It cannot be dug up except by pick or chisel, and in large excavations can be best loosened by blasting. It may be well to state here that in the case of the Manhattan Life Insurance Building, the weight of which is borne on 15 caissons proportioned to carry a pressure at their bases of 10.8 tons per square foot, some of them rest on solid rock and some on the compact stratum mentioned, and that not the slightest settlement can be discovered. As to its safe bearing capacity, there can be no question but that it is well in excess of what under the present building law may be put upon it by means of a concrete base, 150 pounds per square inch, or 10.8 tons per square foot.

As the thoughtful engineer views the building methods prevailing today, it would seem to him that there is perhaps no kind of construction where the force of habit has so disastrously hampered a proper and quick readjustment to new conditions. Buildings of the heights usual until recently seldom put upon the earth supporting them weights greater than 3 or 4 tons per square foot, and generally much less than this. The weights were distributed and spread without difficulty by the common methods that had always been used. Of course, there was occasionally some particular case sometimes treated in an exceptional manner, but these were never important or numerous enough to bring about any radical change either in the general carelessness with which the matter of foundations of buildings was considered, or rather not considered, or in the method of constructing them. Nor was this necessary, because the earth held reasonably well the buildings built upon it, and too, the cost and probable life of the buildings did not warrant a greater expenditure upon the foundations. The weight upon the soil did not compress it to such a degree as to cause serious settlement, nor did it put the material under a pressure which would press it outward or upward if given an opportunity by a nearby excavation. With the sudden doubling of the usual height of buildings, and the consequent great increase of weight, the old foundation methods became, in many cases, entirely inadequate. If pursued, serious settlement was invited from overloading, and the danger of letting down the underlying material by lateral flow became considerable. In fact, the problem of foundations for a heavy building, where they are not carried to rock or hardpan, has now become (and this fact seems to be strangely overlooked) one very largely of what vent may be given for the underlying material by excavations in the vicinity. It is not sufficient that the weight put upon the soil should not be so great as to cause serious settlement. Under the conditions existing this is not generally difficult, but the material must not be put under a pressure that will cause it to squeeze out from below in case an opportunity is afforded by deep excavations nearby. It will become apparent ere long that the erection of heavy buildings resting upon sand or soil, which they unduly overload, without carrying their foundations on piles or to solid material, has in many cases worked a serious wrong to owners of the adjoining lots, besides being itself a short-sighted economy, because of trouble and lessened value of the buildings so built.

For instance, the author knows of one building of great weight, a very excellent and costly structure with a carefully built foundation, which, however, rests simply upon the fine sand into which it has settled slightly. This settlement, as was anticipated, has been uniform and has caused no damage, but the owners are aware of the danger of serious or disastrous settlement that may take place from the operations of putting in foundations of buildings in the neighborhood, even though at a considerable distance from them, for at no great depth below their footing there is material, if it be like that revealed by the near-by operations, which would be likely to squeeze out under the existing pressure, if given a vent, especially if at the same time there is any exciting cause from jarring or pumping. The shoring and underpinning of such a building, while possible, would be vastly more difficult and costly than for a building of but a few stories height. It would, for instance, cost probably more than $100,000 to care properly for the building in question when the property adjoining is built upon, unless the height of the new building were kept considerably below what would now be the height of the most suitable improvement of the property. Under the present building law, when a structure is built alongside another and this latter has its foundations not less than 10 feet below the street surface, the responsibility and cost of caring for the old building must be borne by the owners of the new adjoining one. Thus in the case just cited, when the property alongside the building mentioned is adequately improved, the builders have to grapple with the problem of supporting and probably building a new foundation under this building. Thus the fact that this building, while conforming to the building laws, has put the soil beneath it under unusually great pressure, will cost the owners of the adjoining lots at least $100,000, beside any damage that they may cause the old building. The question very forcibly presents itself, whether in the absence of specific statutes on the subject, the common law cannot and should not be invoked to prevent any owner from putting the soil beneath a new building under such unusual pressure that it is under dangerous tendency to squeeze laterally and thus materially limit his neighbor's future improvement, or else put him under great additional expense in carrying it out. In equity he should certainly be required so to use his own lot as not to injure that of his neighbor. It will be strange if this matter does not soon come up for consideration.

Where soils are overloaded there is extraordinary potency in slight vibration to cause settlement where the conditions are favorable. Hoisting engines are frequently found to be exciting causes in producing unequal settlement in the absence of unequal loading. In one case in lower New York where a very massive and well-built structure resting upon gravel and sand cracked after it had been in use a considerable time, the only new condition introduced to which it seemed possible to attribute the settlement manifested was pumping clear water from a near-by driven well. It seemed reasonable to assume that the water flowing through the sand made possible a slight readjustment of the particles which settled into closer union under the vibration of the machinery in the building.

A most interesting thing often shown by the settlement of buildings

is the frequency of movement of the entire mass of soft material in the vicinity of rivers. There is a locality in New York City where there is good reason to believe such a motion to be taking place. For instance, a certain large and well-constructed building resting upon a well designed pile foundation, and where the piles were driven 40 or 50 feet into the silt, started to settle, probably before it was completed; at any rate, it settled from almost nothing at the end farthest from the river to some 2 feet at the end nearest the river, making a practical wreck of part of the structure. This building was some 200 or 300 feet from the river. An examination of the bulkhead wall showed that the piers had apparently acted as buttresses to hold it back, but that between the piers it was bowed outward. This, in connection with other evidence, seemed to point indisputably to a movement of the entire mass of the adjacent material toward the river, occasioned by the weight of filled material and buildings, and it seemed probable that this movement was shared by the silt to a considerable depth below the filing.

The first method that naturally comes to mind for providing a better foundation than can be done by simply spreading the bearings on the earth at customary depths is that of driving piles, and where there is reasonable certainty that these will always remain wholly submerged, this is generally the best possible foundation, considering its cost, for buildings of considerable but not of the greatest weight. The New York building law permits a load of 20 tons per pile, and engineers will consider this when fair sized piles are used, to be within good practice; but there are many cases where it is certainly a great mistake to take the aggregate bearing capacity of a pile foundation to be the sum of the safe loads on the individual piles composing it. The sustaining power of a single pile may be said to be practically the sum of the friction which holds it on the sides, and the resistance to penetration at its lower end. It is obvious that in very many cases where a large number of piles are driven close to one another, the piles simply replace so much material that has been displaced to make room for them. It is true that the material remaining about them may by the process of driving become so much more compact that it increases the friction and perhaps the resistance to penetration at the lower ends of the piles; but if the stratum below the piles be at all yielding it is probably true that the bearing capacity of the foundation is the bearing capacity of the stratum below the piles plus the friction of what might be considered the outer side surfaces of the entire mass penetrated by the piles. In other words, the piles merely replace so much yielding material and transfer the load to the stratum beneath them.

A practical difficulty which is apt to hamper the building of a good pile foundation for a building very seriously where there are a great number of piles close together is that, after driving the first few, the material near them becomes so conpact that it is exceedingly difficult and sometimes impracticable to get the remaining piles down to anything like the contemplated depth. It may be comparatively easy to drive the first one, say 30 feet, and may become exceedingly difficult to drive those put down later to a depth of more than 10 or 15 feet. This difficulty is readily overcome where the use of the jet may be resorted to. This is often dangerous in proximity to other buildings, and, too, it sometimes seriously cracks the adjoining building to drive piles close to it.

With regard to the piles remaining permanently submerged, there have been some rather startling experiences in New York City. There is one building, the value of which is probably in the neighborhood of $1,000,000, built upon piles, the upper ends of which it was found before the completion of the building would be shortly exposed, and it is said that it was decided to inclose the entire foundation in a dam, so to speak, in which the water is kept by pumping at a safe height to cover the piles. One of the leading builders in New York a short time ago removed a building which rested on piles driven but a dozen years ago, and he found them seriously decayed. Throughout the gravel and sand deposits of the lower part of New York there is an abundance of fresh water, which rises and falls to a greater or less extent with the pressure of tide water upon it. The supply from springs must be very great, because there are a vast number of driven wells throughout the region, supplying water for steam and other purposes. The water level at any one point may be materially lowered at any time by pumping from a driven well in the vicinity or from the constant drainage of some leaking basement or other excavation. Thus it would seem that the permanence of any given water level in the city can rarely be relied upon.

In considering the provision of an adequate foundation for a building, the weight of which seems to require something better than the old style of simple foundations, the first natural thought is to increase in some way the spread of the foundation so that the unit weight on the material may be kept within allowable limits. In Chicago, where the material on which the city is built consists generally of a thickness of 40 to 100 feet of blue clay of more or less yielding character which can scarcely be loaded safely two tons per square foot, the general practice has come to be that of proportioning the area of the column foundations in a uniform ratio to the column loads upon them, in order to get equal settlement under all the columns. This has resulted in the so-called raft system of foundations, in which, by alternate layers of steel beams of lessening length, it is practicable to spread the bearing to a sufficient extent. This method requires the minimum depth of excavation and gives the minimum amount of cellar space. Short of some method of carrying the bearings to a lower and more substantial stratum, as by piles or by excavation to bedrock, this would seem to be the best possible treatment of the problem under such conditions as exist at Chicago. That this method should be at all satisfactory requires a comparatively uniform condition of material under the entire building, uniform in character, in compressibility, in softness, and in depth.

This raft method has been employed in some cases in New York. For buildings in the lower part of the city it is open to the objection that the conditions under the entire building are not apt to be uniform, and there is often a very serious objection that at some part, if not under the entire building, the material at some depth may be sandy, or of the nature of quicksand, and may yield or be relieved at some future time. Of course, there is always the question as to the durability of steel beams, even though incased in concrete, where they are below the water level.

In considering the loads to be provided for by the foundations for the Manhattan Life Building it was found that if piles were driven over the entire space to be covered by the building, enough piles could not be driven on the lot to sustain the building and load the piles within the limit permitted by the building law. Thus, unless the simple method of spreading the foundations were considered satisfactory, which in this case was out of the question, there was no way but to carry the column loads from the bedrock, which in this case was 54 feet below the Broadway street level. The borings taken on the lot indicated the existence of more or less quicksand, and it was feared that any effort to excavate for foundations in the open to the bedrock would result in an inflow of material that would endanger the adjoining buildings. For this and other reasons, the architects, Messrs. Kimball & Thompson, decided upon the use of steel caissons sunk by the pneumatic process, and thus came about the first use of this method.

Its advantages are: 1st, the excavation can be carried on under pressure, which holds back from inflow any outside material; 2d, any obstructions met with in the sinking can be removed without serious difficulty or delay; 3d, the bottom can be examined, and, where necessary, leveled or stepped; 4th, the work can be executed with speed, because the caissons can be brought on the lot, finished or ready to put together, and while these are being sunk the brickwork to form the permanent pier can be built upon them, so that when the excavation for each foundation is completed the pier itself is finished. This method has been employed in obtaining foundations for the American Surety Building and the new Standard Oil Building, and its use is contemplated in other buildings soon to be erected. It would not seem worth while to deal in detail with the construction and sinking of the caissons, because the general method is familiar through its application to bridge foundations. Some points, however, should be mentioned. In these comparatively small caissons with vertical sides, sunk the entire distance through earth, the friction is in much greater proportion than occurs in bridge work. As soon as the brickwork, built as high as is practicable, proves of insufficient weight to make the caisson follow the excavation against the upward pressure of the air and the friction, it becomes necessary to put on a temporary load. This is done by piling on pigs of iron. Another respect in which this work differs from bridge work is the fact that excavations in the material should preferably be carried on by means of a Moran or other lock without permitting reduction of the air pressure.

Of course when the depth to hard bottom is not great and there is no running material over it, the excavation may be made in the open air under the protection of sheet piling, and this is in such cases the simplest and cheapest means of doing the work. The foundations for the new Johnston Building have been successfully put in by means of open wrought iron cylinders sunk by the water jet process. This method, while somewhat cheaper than the pneumatic, would seem to be open to the objection that it might not permit in some cases a proper examination and preparation of the bottom and of building the foundation in the dry, and, too, should flowing material under heavy pres-

sure from beneath an adjacent building be encountered, a possibly dangerous vent might be afforded. As yet the pneumatic process is the one safe and sure method for deep excavations, by which all dangers of quicksand or other difficulties can with certainty be quickly overcome and a perfect foundation constructed, and this, too, at a cost, where the conditions are determined, which can generally be estimated with comparative certainty.

* * * * * * * * * * *

The author wishes to apologize for the absence of detail in this paper; it was intended to present only general considerations. The time would seem ripe for discussion of the matter of foundations of buildings. It should be brought to the minds of architects and property owners that soils, like metals and woods, have limits of strength and cannot be overloaded without inviting trouble. If there is an absence of that principle to do things well, which should be an instinct with everyone who builds, they must be shown the false economy of their inadequate methods.

This general consideration of the subject treated has been offered in the hope that it will call forth valuable discussion, and that its author is not mistaken in assuming the Society to be the center from which such good influences as are needed must emanate.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

Mr. J. W. Alexander, who served the Painesville (O.) Gas Light and Coal Company as President and Manager since 1880, has resigned from the named positions, in order to devote his entire time to other important business interests. Mr. George P. Steele succeeds him as President and Manager of the Painesville Company.

The Chicago offices of the Maryland Meter and Manufacturing Company have been removed from 122 and 124 Michigan street to 107 West Monroe street.

The Metropolitan Gas Company, of Los Angeles, Cal., has perfected its organization by naming the following officers: President, Datus C. Smith; Vice-President, W. J. Washburn; Secretary, A. Jacoby; Treasurer, H. J. Woollacott; Attorney, Matthew T. Allen.

The Board of City Trustees, of Santa Ana, Cal., have agreed to expend the sum of $28,000 in the equipment of an electric lighting plant, to be operated on municipal account.

The Boston and Montana Consolidated Copper and Silver Mining Company, of Great Falls, Mont., is erecting a new electrical power house in connection with its large mining plant. This building is to be modern in all respects. The Berlin Iron Bridge Company, of East Berlin, Conn., has the contract for furnishing the steel work. The building will be absolutely fireproof, and the covering will be lined with the Berlin Company's patent anti-condensation roof lining. This material has proved itself to be very efficient for lining engine and dynamo room roofs, and the Bridge Company is constantly receiving orders for this work from all parts of the country.

President Smart, of the Port Hope (Canada) Gas Company, has notified the residents that the Company will sell gas stoves for cooking purposes, at wholesale cost to itself; further, the Company will make the necessary connections without charging therefor. A representative stock of gas cookers is carried in the Company's handsome offices on Walton street, where competent advisers are ready to explain all about the method of operating apparatus for cooking by gas. This liberal and businesslike policy, added to the low rate ($1.25 per 1,000 cubic feet) at which gas is sold by the Port Hope folks, should cause a sensible increase in the Company's output this summer.

The Wilkes-Barre (Pa.) *Record* says that a controlling interest in the Consumers Gas Company of that city has been acquired by Messrs. Edward C. Jones & Co., of New York, and Liddon Flick, of Wilkes-Barre, representing a syndicate. The price paid was $65 per share, on a par of $50. The syndicate also agrees to take all the outstanding stock within a reasonable time at the price reported.

At the annual meeting of the Altoona (Pa.) Gas Company the officers chosen were: Directors, John Lloyd, W. D. Couch, H. C. Dern, J. R. Bingaman, W. C. Leet, A. C. Shand and T. B. Patton; President, John Lloyd; Treasurer, W. D. Couch; Secretary, W. D. Gerst.

The 36th annual meeting of the German Association of Gas and Water Engineers will be held at Berlin, Prussia, June 15th, 16th and 17th. In connection with this we might also note that the Industrial Exhibition at Berlin, which was opened by the Emperor, with impressive ceremony, on May 1st, has, among others, a building devoted entirely to the gas industry and water supply. It is expected that the German Gas and Water Association will have arranged in the said building, before the date of its meeting, an aggregation of exhibits comprising a most complete arrangement illustrative of the development of the lighting industry from the earliest to the present time. There will be a collection of the literature on lighting and water supply from all the civilized countries, and an exposition of every description of apparatus for the production and application of gas. In fact, it is intended that the gas exhibit will be as complete as it is possible to have it. The meetings of the Association will be held in the building assigned to chemistry, and the time devoted to the assemblies in the meeting hall will begin at 9 A.M. and terminate at 1 P.M. The programme indicates a most entertaining and instructive time, the pleasures and instruction of which are to be shared by all who participate.

At the annual meeting of the shareholders of the Pittston (Pa.) Gas Light Company the officers chosen were: President, Mr. Andrew Bryden; Treasurer, Mr. Andrew B. Law.

The shareholders of the Bethlehem (Pa.) Gas Company, in annual meeting assembled, selected the following Board of Directors: A. H. Rauch, H. B. Luckenbach, S. Rau, J. S. Krause, J. M. Leibert, A. C. Borhek, F. E. Luckenbach, C. H. Eggert and F. H. Jacobson. The Directors eventually perfected this organization: President, J. S. Krause; Secretary and Treasurer, J. M. Leibert.

The fuel of the poor (gasoline) must be a very dangerous article, in testimony whereof we point to the ghastly result at Cincinnati, in the first week in May, when 10 met their deaths and many others were injured through the misuse of the stuff. Those who will use light vapors in cooking stoves may not look for recompense from those who sell the vapors; but another way out of the danger from the use of liquid inflammables is—not to use the inflammables.

We understand that the proprietors of the Nevada (Mo.) Light Company have discontinued the electric lighting division of their lighting plant, and will hereafter depend upon their gas sales for a profit.

At the annual meeting of the Owosso (Mich.) Gas Light Company a new rate schedule was put in force. The gross rate remains at $1.50 per 1,000 cubic feet, but rebates on yearly quantities, in accordance with the table appended, are to rule: 100,000 to 200,000 cubic feet, 20 cents per 1,000; 200,000 to 300,000 cubic feet, 30 cents per 1,000; 300,0000 to 400,000 cubic feet, 40 cents per 1,000; 400,000 to 500,000 cubic feet, 50 cents per 1,000; 500,000 to 600,000 cubic feet and over, 60 cents per 1,000. The rebate is payable after May 1st of each year.

At the annual meeting of the United Gas Improvement Company the following Directors were elected: Thomas Dolan, George Philler, P. A. B. Widener, Wm. L. Elkins, Wm. W. Gibbs, C. A. Griscom, Samuel T. Bodine.

A correspondent forwards the following, under date of the 17th inst.: "The stockholders of the Freehold (N.J.) Gas and Electric Light Companies held their annual meeting on the 4th inst., in the office of Mr. Charles A. Bennett. They elected as Directors the following: Messrs. Charles Ellis, H. V. M. Dennis, D. V. Perrine, Charles H. Butcher and E. D. Bedle. On the following afternoon the Directors perfected the following organization: President, D. V. Perrine; Vice-President, Chas. Ellis; Secretary and Treasurer, C. H. Butcher; Manager, E. B. Bedle. Messrs. Chas. A. Bennett, C. B. Ellis and F. B. Conover, former Directors and large shareholders, have sold out, although Mr. Bennett may still retain a few shares. Mr. Bennett was Secretary of the Company for 39 years, and was also Treasurer for quite a while. The Company will retain its showroom on East Main street, but will dispose of the rest of its town property."

Mr. Geo. A. Woolverton, formerly prominent in the management of the Peoples Gas Company, of Albany, N. Y.—he was its President for several terms—died at his home in Albany on the morning of the 5th inst. He was in his 83d year, and had amassed a fortune in the boot and shoe trade.

The U. S. Projectile Company, of Brooklyn, N.Y., is erecting a new building to meet the increasing demand for its products. The new structure will be 100 feet wide and 450 feet long, of steel skeleton structure throughout. The steel work for the building has been designed and will be erected by the Berlin Iron Bridge Company, of East Berlin, Conn. The trusses are to have a clear span of 100 feet, and the general construction of the building will be such as to make it one of the notable structures of the country.

MR. FREDERICK SUNKEL, Mayor of Belleville, Ills., in his annual message to the City Council, had this to say about the gas supply of that city: "I will state that the quality of the light furnished by the Belleville Gas Light and Coke Company has been more satisfactory during the last year than ever before."

AT the annual meeting of the Erie (Pa.) Gas Company the Directors chosen were: Chas. M. Reed, Wm. Spencer, Wm. S. Brown, G. R. Metcalf, J. P. Metcalf, J. S. Richards and Chas. Brandes.

THE executive management named by the Rhinebeck (N. Y.) Gas Company is appended: President, John J. Williams; Treasurer, Dr. C. B. Van Etten; Secretary, R. R. Rikert. The management is well pleased over the results following the plant improvements recently completed.

THE Lansing (Mich.) Gas Light Company will establish itself in new and commodious offices, at No. 204 Washington street South. A show room for gas appliances will be a leading feature of the outfit.

THE New Haven (Conn.) Gas Light Company has determined to collect its accounts monthly, instead of quarterly as heretofore.

THE Light Committee of the Montreal (Can.) City Council has empowered the official inspector (Mr. Badger) to expend $1,000 in the purchase of the necessary instruments to test the quality of the gas supplied in that city.

THE following inclosure from a correspondent, forwarded under date of the 9th inst., explains itself: "All question as to the condition of the gas mains which the Hartford (Conn.) City Gas Light Company is having laid on Central row, from Prospect to Main street, was settled yesterday by an examination being made by Henry Souther, an engineering expert in the service of the Pope Manufacturing Company. Mr. Souther was selected by City Surveyor Bunce to make an examination of the mains, the Gas Company having withdrawn its men and suspended work until after the City Surveyor satisfied himself that the pipes which were being put down were of the proper quality, as was stated. The Street and Health Boards had caused no little excitement among the property owners on Central row when they brought the matter up at their meetings for action, claiming that the pipes were unfit for service and injurious to public health. The matter was first brought up before the Health Board, and that body referred the matter to the Street Commissioners, who, after discussing the question, had this resolution passed, which was sent to the Gas Company:

"'*Resolved*, That the Hartford City Gas Light Company be ordered to replace the pipes recently laid in Central row with suitable and proper pipes, and that said Company is hereby directed to lay no pipes in said Central row except suitable and proper pipes. That said pipes recently laid in said street must be relaid with suitable and proper pipes on or before the 15th day of May, 1896, and that the Clerk of the Board be directed to serve an attested copy of this resolution, signed by said Clerk, on said Company, on the 7th day of May, 1896.'

"Following this there came to the Company the appended communication from the Board of Health:

"'HARTFORD, May 7, 1896.

"JNO. P. HARBISON, Treasurer, Hartford City Gas Light Company: At a meeting of the Board of Health, held May 6, 1896, it was voted that the Hartford City Gas Light Company be, and is hereby ordered to cease laying pipe of poor and defective quality in Central row, and to remove such pipe already laid.'

"In reply to the letter received from the Board of Health, General Harbison sent this letter:

"'Gentlemen: Your esteemed favor of the 7th, covering copy of vote passed at your Board meeting, held May 6th, is received and its contents carefully noted. In reply, we have pleasure in informing your honorable Board that this Company, during its history of nearly 47 years, has not in any case laid in the streets of Hartford, or elsewhere, any poor or defective pipe for carrying gas to its consumers, nor does it intend to do so at any time in the future. Very respectfully yours, JOHN P. HARBISON, Treasurer and General Manager.'

"At the meeting of the Street Board it was decided to have an inspection made, and yesterday the examination was made by Mr. Souther, the expert at Pope's, in the presence of City Surveyor Bunce and one of the foremen in the employ of the Gas Company. The expert drilled holes in several pieces of the pipe which had been laid on the street and which had been covered in the trench, and found them to be in good condition and suitable for the purpose for which they are being laid. A report of the expert's opinion to this effect was furnished the City Surveyor and to the Gas Company. Afterwards, City Surveyor Bunce issued the following order to the Gas Company:

"'HARTFORD, May 8th, 1896.

"'John P. Harbison, Treasurer Hartford Gas Light Company—Dear Sir: I hereby notify you that you may continue the laying of the 6-inch pipe on Central row, upon the condition that all pipe to be laid shall be subject to my inspection and approval, and that no pipe shall be laid having a thickness in any part of its wall of less than $\frac{7}{16}$ of an inch. Upon acceptance of these conditions the work may immediately proceed. Yours respectfully, C. H. BUNCE, City Surveyor.'

"When seen yesterday afternoon, General Harbison said: 'The pipes which the Company is laying in Central row, and to which the objection was made, are 6-inch pipes, which we have taken out of Main street, where 16-inch pipes are replacing them. The pipes, although laid in 1849, are in as good condition to-day as on the day they were originally buried. There is a coating of earth upon the outside of the pipes which gives them an old appearance, but nevertheless they are of sound quality, or the Company would never relay them. We are laying the 16-inch pipes through Main street in order to give a better supply to consumers in the north section of the city, and the 6-inch pipes were being put down in Central row to replace the old 3-inch pipes which have been there.'"

A CONTRACT for the erection of 12 benches of 6's on the works of the Toledo (O.) Gas Light and Coke Company has been awarded to the Parker-Russell Mining and Manufacturing Company, of St. Louis.

A CONTRACT for the resetting of 11 benches of 6's, to the order of the Board of Gas Trustees of Wheeling, West Va., has been awarded to Mr. Jas. Gardner, Jr., of Pittsburgh, Pa.

MR. JAMES FORBES, Superintendent of the Chattanooga (Tenn.) Gas Light Company, in a letter dated the 11th inst., referring to the meeting of the Western Association, says: "I believe we will have a splendid meeting. To wind up with we will have a drive to Chattanooga and Chickamauga National Military Park and back to Chattanooga by way of Missionary Ridge."

THE Jenkins' special train to Chattanooga from Cincinnati will arrive at 8 o'clock P.M. of to-morrow, and the special train conveying the Eastern contingent, which leaves the depot of the Central Railroad of New Jersey at 5 P.M. of to-day, will reach Chattanooga at about the same time that the Jenkins' special is due. The Eastern special route is over the Baltimore & Ohio system to the Norfolk & Western Road, thence over the line of the East Tennessee, Virginia & Georgia Co. to the point of destination. The route is a beautiful one, and even with ordinary weather the trip should be a most enjoyable one, for the party is sure to be congenial.

THE Inter-State Gas Company, which is controlled by capitalists of Toledo, Ohio, has purchased the plant of the Urbana (Ohio) Company.

AT the annual meeting of the Pottstown (Pa.) Gas Company the officers elected were: Directors, Dr. Chas. Moore, Jacob S. Bahr, L. P. Evans, T. J. March, C. F. Sisler, F. W. Van Buskirk, Jonathan Kehl and M. B. Casselberry; President, Dr. Chas. Moore; Secretary, Jacob S. Bahr; Treasurer, Wm. H. Smith.

MR. J. O. HUDSON, Supt. of the Bordentown (N. J.) Gas Company, announces that, until further notice, these net selling rates will prevail: For lighting purposes, $1.65 per 1,000; for cooking purposes, $1.25 per 1,000.

Petroleum Joints for Common Iron Pipes.

A writer in *Cassier's Magazine* says that "to make a good petroleum joint with common iron pipes, a very good system is to heat both the male and female threads sufficiently to dissipate every trace of oil. Then make the joint up with thick shellac varnish, which may be combined with ordinary dry vermilion or even Venetian red. A joint of this kind I have found to stand well. A very good joint can also be made with ordinary yellow bar soap rubbed into the threads of the pipe, the grease first being removed. Treacle, honey, glue, mucilage, or glycerine, are quite petroleum-proof. For a stuffing box, ordinary wicking, saturated with common yellow bar soap, may be safely employed. Canvas, saturated with shellac varnish, makes a good washer, but soft metallic washers are better. A very good flexible diaphragm for a regulator may be made of closely woven cotton fabric, varnished on both sides with a compound of gelatine and glycerine. About equal parts by weight make a very tough and elastic compound. Wooden vessels, bags, etc., may also be made petroleum-tight by saturating or varnishing with this compound. As a rule, all substances which are soluble in water are quite insoluble in petroleum. For stuffing boxes for standing both water and petroleum, castor oil may be employed, as this peculiar oil seems quite insoluble in either."

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MONDAY, MAY 18, 1896.

The Market for Gas Securities.

The market for city gas shares was very uneven last week, and the professional peggers had things very much their own way. Consolidated sold as low as 155½, according to the Exchange reports. At noon to-day (Friday) it was returned at 156 bid. A certain well-known house on Broadway, above Cedar street, is active in the bear movement, but their tactics are not according to the manual. We advise the purchase of Consolidated in the most positive terms. Other city shares also feel the uncertainty of the time, still they look cheap to us at ruling figures. The Brooklyn Union Company has declared a dividend of 3 per cent., payable June 1st, and the shares are quoted at 96 to 97. Bay State is steady, at 30½ to 31, and the first fives are 86 bid.

Chicago is weaker, presumably on an arrangement for the construction of the works of the Ogden Company. Baltimore Consolidated is offered at 62½. The Company has declared a semi-annual dividend of 2½ per cent., payable June 1st. San Francisco gas is in demand at 93 to 94. Consumers, of Jersey City, is neglected, at 82. Western, of Milwaukee, is strong, with 65 freely bid for it. The Indiana stocks are very firmly held in spite of a notable advance in the bid rates.

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Kerr Murray Mfg. Co., Fort Wayne, Ind..... 796
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R. D. Wood & Co., Philadelphia, Pa..... 798

WANTED,

A Competent Man to Operate Water Gas Plant, Lowe Style.

State wages, with references,

"O. G.," 703 Girard Building,
1093-3 Phila., Pa.

Engagement Desired.

Practical, experienced man, understanding meters and prepayment meters, wants position in the gas or meter business.

Address "G.,"
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Position Wanted.

Experienced man desires position as Superintendent of Gas Plant or Gas and Water Plants combined, or construction of either. Twenty-five years' practical experience. Last position nearly 7 years. Address

"G. H. H.," 3222 Pacific Avenue,
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Position Wanted

As Superintendent of Gas Works or Gas and Electric Light Works.

Has been in the employ of the Long Branch (N. J.) Lighting Company as Superintendent for the last 11 years, and is a practical mechanic, thoroughly understanding the laying out and erection of plant and the making of coal and water gas. Best of references. Address CHAS. J. LUTHER,
1093-2 Box 142, Long Branch, N. J.

Position Wanted

As Superintendent of Gas Works.

Has been in the employ of the Passaic (N. J.) Gas Company for the last 10 years as Superintendent, and is a practical mechanic, thoroughly understanding the laying out and erection of plants and the making of coal and water gas. Seventeen years' experience as constructor and builder with John Hanlon, Gas Engineer. Best of references. Address
1095-10 FRANK JONES, Passaic, N. J.

WANTED,

Seven-Foot Station Meter.

in good order.

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WANTED,

A Second-Hand Wood's Condenser,

Capacity, 50,000 to 75,000 feet per day. Also,

Station Meter, 5 x 5.

State price and condition. Address "A. H.,"
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FOR SALE,

Four Purifying Boxes, 8 ft. by 8 ft.,

with 6-inch Center Valves and Connections, in good order.

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Utilize Your Gas Liquor.

NO EXTRA LABOR OR OPERATING EXPENSES.

Ammonia Concentrator.

Not Expensive. Write to STRCH & OSIUS, Pat'ees, or Mich. Ammonia Works, Detroit, Mich.

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For Welsbach Lights.

Send for Catalog and Discounts.

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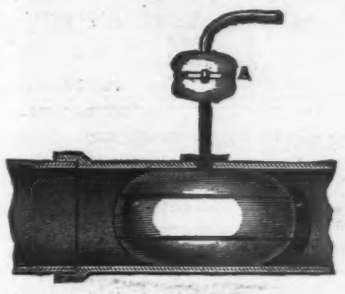
MICASMITHS,

No. 88 Fulton St., N. Y. City.

Peerless Patent Improved Gas Bag



These Gas Bags are used to stop the flow of gas while repairing or making alterations in gas mains. There have been numerous cases of workmen being badly injured, and sometimes fatally, by the escape of gas resulting from the bursting of a bag, and our patent improvement is designed to obviate such calamities. The indicator *A* shows unerringly when the bag has been sufficienty inflated to pack the main, and when the pumping should be stopped. Our Bags are made of a rubber stock especially prepared to admit of great distension, and to resist the action of Oils, Gases, Naphtha and other residuum in the mains, and they are made with lapped joints, which adds greatly to their strength.

3-in.	Gas Bag,	each,	$0.60	12-in.	Gas Bag,	each,	$5.00
4 "	"	"	.80	16 "	"	"	8.25
5 "	"	"	1.05	20 "	"	"	12.00
6 "	"	"	1.75	24 "	"	"	17.00
8 "	"	"	2.65	30 "	"	"	27.50
10 "	"	"	3.75				

The Peerless Rubber Mfg. Co.

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THE ANDERSON Patent Cutter Carrying Link

Made in all sizes.

Will cut from 2 in. to 24 in.

Pipe Cutting Tool

For Cutting Cast, Wrought Iron, Gas & Water Pipes.

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EAST BOSTON, MASS., or

WALDO BROS.,
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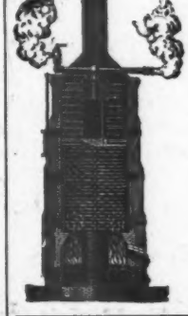
The Pioneer Vertical Water-Tube Boiler of the World!



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After Sixteen Years of Active Service in all the Principal Industries, this Boiler has Proven Itself Superior to all Others in Economy of Fuel, Durability, Safety and General Efficiency.

NO EXPLOSIONS OR ACCIDENTS OF ANY KIND.

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Cable Address, "Palla," New York.
Tele., "1229-18th St.," New York.

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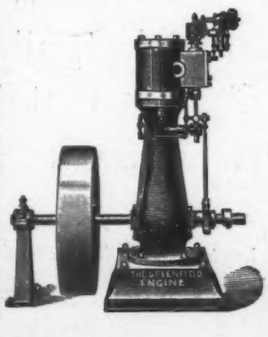

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Established 1874.
MANUFACTURERS OF

Greenfield Stationary, Portable and Yacht ENGINES AND BOILERS.

Also Horizontal, Automatic and Variable Cut-off Engines.

Sizes from 3 to 75 Horse Power.

Also Vertical and Horizontal and Marine Boilers. Steam Pumps and Adams' Crate Bars.

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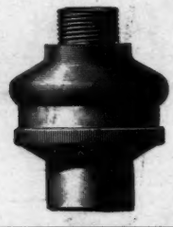

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Has been made by
WILDER'S VOLUMETRIC GOVERNORS.
They control the pressure at the burner, and deliver the quantity for which they are set regardless of high or low pressure in the supply.
WELSBACH LIGHTS are fully controlled, and the governors soon pay for themselves by preventing the breaking of mantles and chimneys. Thousands are already in use. Orders may be given to the Welsbach Co., or sent to ourselves.
THE WILDER MANFG. CO., - 816-822 Cherry St., PHILADELPHIA.

Patent Lava Gas Tips.

UNIFORMITY GUARANTEED.
ALL SIZES AND SHAPES.
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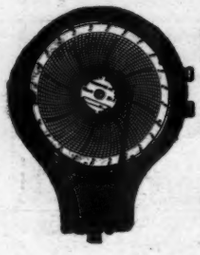
For Continuous Records of
Street Gas Pressure.
Simple in Construction,
Accurate in Operation,
Low in Price,
Fully Guaranteed.
Send for Circulars.
THE BRISTOL CO.
Waterbury, Conn.
Received Medal at World's Columbian Exposition.

HERMAN POOLE * Chemical Engineer,
323 West 34th Street, N. Y. City,
Makes a Specialty of
PURIFICATION
And the Utilization of Waste Products in Gas Manufacture.

C. W. HUNT COMPANY.

THE HUNT TIP CAR.
COKE CARS for Gas Works,
TIP CARS for Carrying Ashes,
CHARGING CARS for Bringing Coal from the Storage Bins to Boiler Room and Retort Houses.
INDUSTRIAL RAILWAYS
Specially designed for handling material in and around
Gas Works, Coal Yards, Factories, Etc., Etc.
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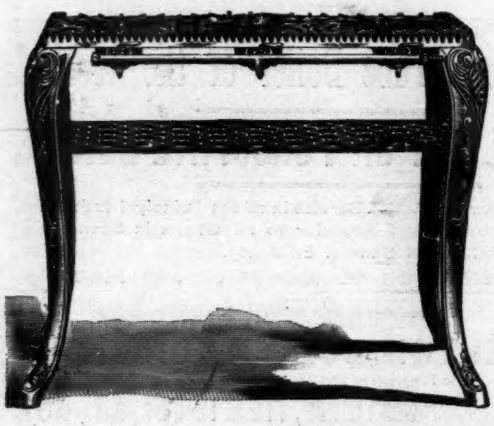
of our efforts to please the gas consuming public. "Our long legs" have raised us beyond the reach of competition. The advantage of High Hot Plates is readily apparent. Table room saved, and no bracket nor "bummy" looking goods-box necessary.
Housekeepers take to this Stove.
NINE STYLES OF LOW HOT PLATES,
and the cheapest Ranges in the market, all fitted with the wonderful Keystone Burner. Write for Catalogue and Discounts.
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CAHILL, SWIFT & CO.,
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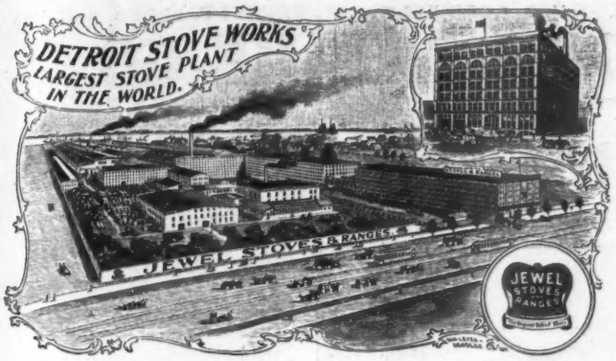


DETROIT STOVE WORKS,

MANUFACTURERS OF

Detroit Jewel Gas Stoves.

WE cordially invite all who will attend the Nineteenth Annual Meeting of the Western Gas Association, on the 20th, to visit our exhibit of Gas Ranges, arranged by courtesy of the Chattanooga Gas Co. at their office. Our Southern representative, Mr. J. L. Wyatt, will be in attendance. He is a resident of Chattanooga, and will be pleased to meet anyone who can spare a few moments' time. We make superior goods at low prices, fill all orders promptly, and don't make Gasoline Stoves, but use every effort, and advertise extensively, to crowd the Gas Stove department of our business.

DETROIT STOVE WORKS, - Detroit. Chicago.

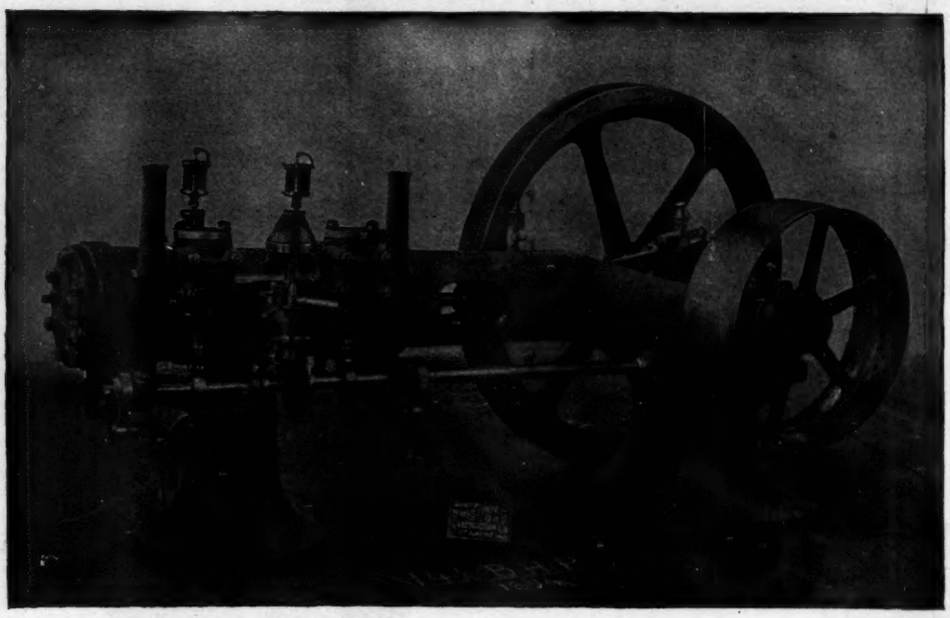
WM. W. GOODWIN, Prest. O. N. GULDLIN, V.-Prest. & Treas. H. B. GOODWIN, Sec. ERNEST F. LLOYD, Asst. Sec

THE AMERICAN GAS ENGINE CO.,

MANUFACTURERS OF

The Double-Acting Gas Engine,

Under the Patents of Griffin, and Dick, Kerr & Co., of London and Kilmarnock.



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Single Cylinder.

Impulse Every Revolution.

(Two Strokes.)

15 to 500 Horse Power.

For General Work and Isolated Electric Plants.

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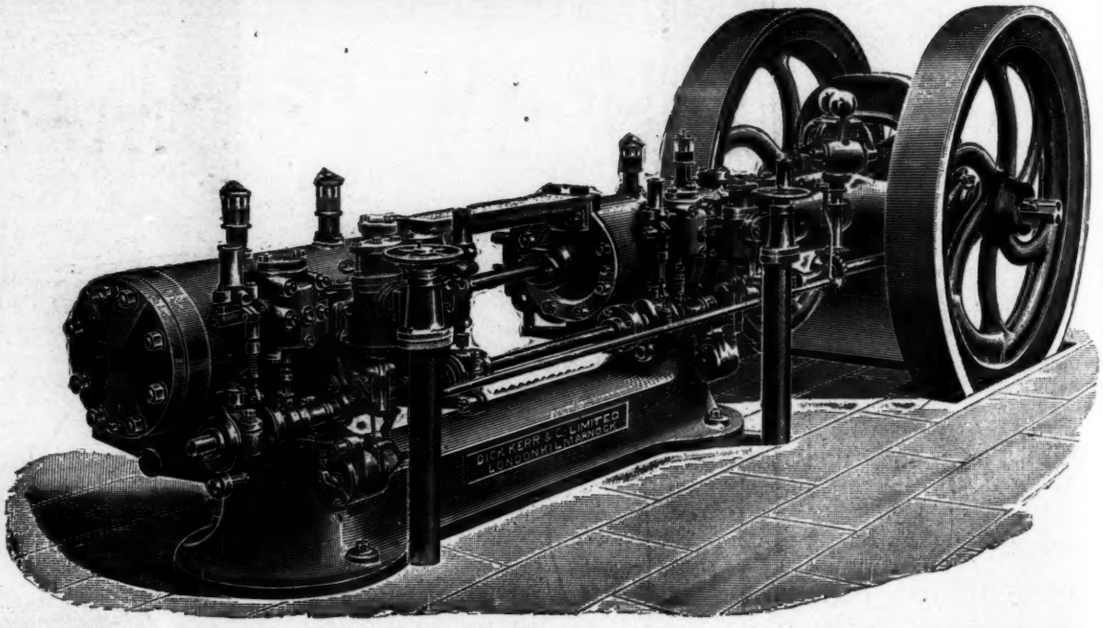
Tandem Cylinder. Impulse Every Stroke. 100 to 1,000 Horse Power.

For Central Stations and all work requiring extreme steadiness.



ESSENTIAL PRINCIPLE.—An impulse at each end of piston; using half force to each impulse; doubling the steadiness; reducing the wear on moving parts, and weight for given power. **CONSTRUCTION.**—The piston rod works through stuffing box in front end of cylinder, and connecting rod is carried in a cross-head working in a slide in frame, as in ordinary steam engine practice. All valves are of the poppet type, operated by cams on a single cam-shaft, giving positive movement to every working part. Tube or electric ignition. **RESULT.**—An engine of extreme simplicity and steadiness of action, the even wear on the cylinder and all working parts assuring increased economy, long life, and minimum cost in repairs. **RECORD.**—Successful and constant use in Great Britain for the past eight years. Address

W. W. GOODWIN, President, 532 Bourse Building, Philadelphia, Pa., or
THE WESTERN GAS CONSTRUCTION CO. Bldrs. & Gen. Agts. Fort Wayne Ind.

The Improved

Welsbach Light.

No. 34 Burner, with No. 74 Shade.

No. 34 Burner, with Nos. 10 and 43 Shades.

Welsbach Commercial Company,

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AMERICAN GAS COMPANY,

222 South Third Street, Philadelphia, Pa.

Owns, Operates, Buys and Leases Gas Works.

ALSO UNDERTAKES ALL KINDS OF CONSTRUCTION WORK.

Especially the Installation or Extension of Plants for the Manufacture of Gas from Caking Coal.

The attention of Gas Managers is particularly called to the many improvements in this method of manufacture instituted during the past fifteen years, and the extremely low cost at present of Coal Gas.

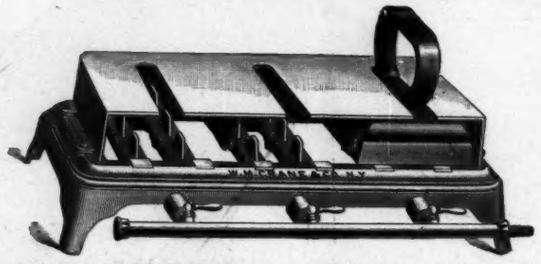
CORRESPONDENCE RESPECTFULLY SOLICITED. Address

GEO. G. RAMSDELL, Gen'l Mangr.

We Make Everything in the Line of Gas Appliances.

VULCAN TAILOR and LAUNDRY STOVES

Are Fitted with our Patent Burners and Adjustable Air Mixers, Insuring a Perfectly Blue Flame.



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Tailor Stove for 28 lb. Goose. Space for Iron, 4 1-2 inches.

RECOGNIZING the fact that there is a great field before us in the line of Gas Appliances still undeveloped, and our business being exclusively in this line, we aim to keep the lead and retain the reputation of producing goods that are up to date and can be relied upon as represented. We manufacture a number of Specialties not illustrated in our Catalogue, and invite correspondence.

W. M. CRANE & CO.,

MAKERS OF GAS STOVES AND APPLIANCES.

Office, 838 Broadway, N. Y. City.

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THE LITTLE GIANT (SUTHERLAND'S IMPROVED LOWE) GENERATOR.

The Most Economical, Efficient and Reliable

WATER GAS APPARATUS

In the World for Small to Medium Works.

Can be put into Coal Gas Works at a price the interest on which will not be so much as their present repair account.

This Generator is now in use in nearly every State in the Union, and everyone using it will recommend it to you.

It makes a faultless gas from whatever gas-producing materials are cheapest in the locality where required, using hard coal or coke in connection with Lima crude or any other crude petroleum or its distillates, including *Naphtha of any specific gravity.*

I build these Generators with any required capacity, from 3,000 cubic feet per hour upward.

In more than one half the gas works in the country the "Little Giant" will enable *one man* to easily make, in *five hours*, all the gas needed for the *twenty-four hours.*

If gas coal is very cheap and anthracite coal and hard coke very expensive with you, put in a Little Giant Generator, as many others have done, *to use up your surplus coke, and to rush up your holder when hard pressed.*

All work and results guaranteed.

Contracts Taken for Entire Works and Special Attention Given to Holders.

A. M. SUTHERLAND, - - - - No. 231 Broadway, N. Y. City.

JEWEL GAS STOVES

A few of the world's best Gas Stoves. All prominent demonstrators of cooking use them. Nine-tenths of the Chicago apartment houses are furnished with the same . . . . . .

One Name
Covers All.

52 Styles of Cookers.
54 Styles of Heaters.

A JEWEL CATALOG
IS WORTH THE ASKING.

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BEST IN THE WORLD.

The accompanying cut shows our New Table Gas Range, which is listed at only **$12.00.** This is the Gas Stove to sell to the majority of people, who hesitate about paying out very much money for a large Gas Range.

We have gotten out more new patterns than any other manufacturer of Gas Stoves in the World. . . . . .

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BEST IN THE WORLD.

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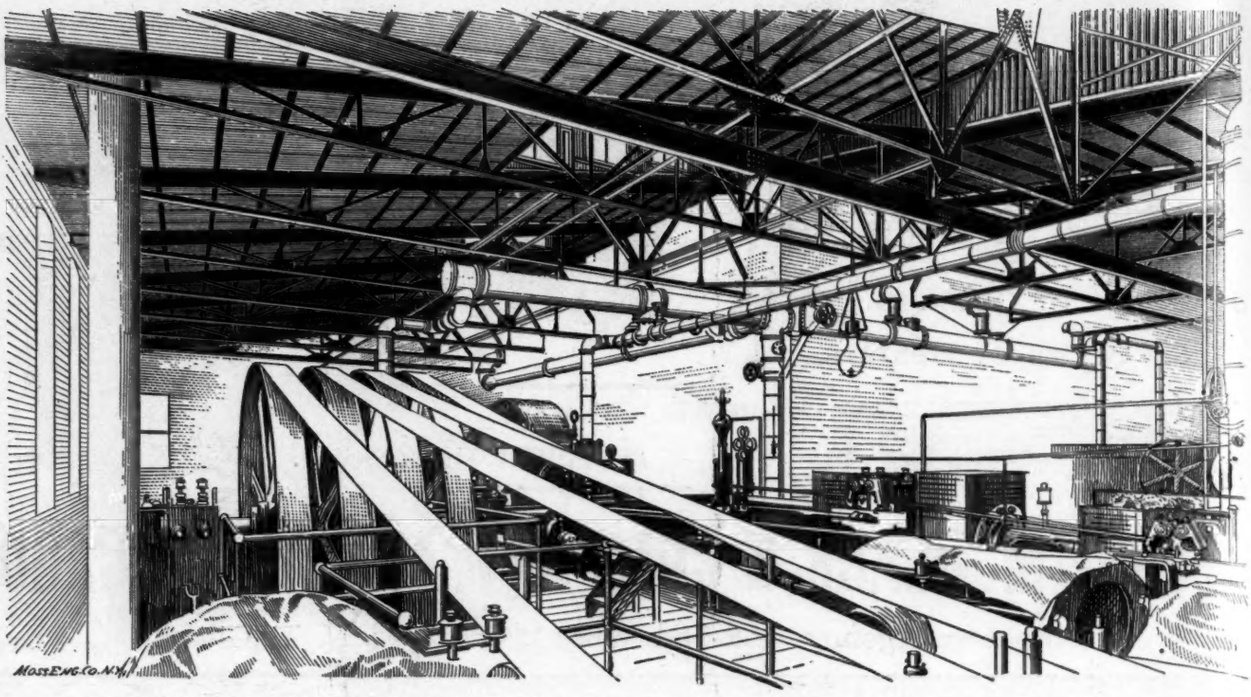
Engineers, Architects, and Builders of Iron and Steel Structures.



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Write for Illustrated Catalogue.

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THE MANAGEMENT OF SMALL GAS WORKS.

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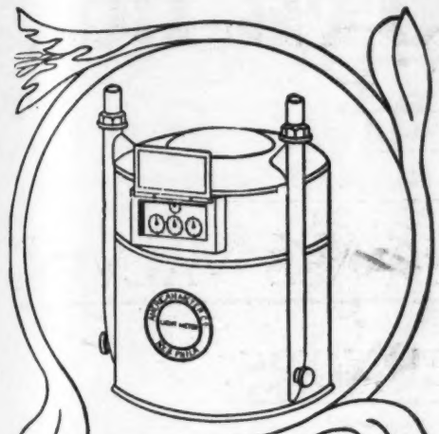

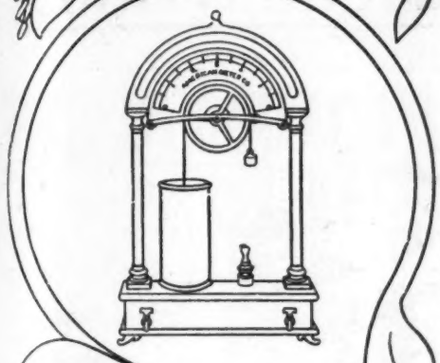

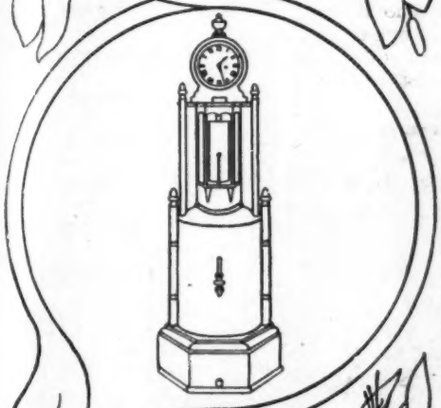

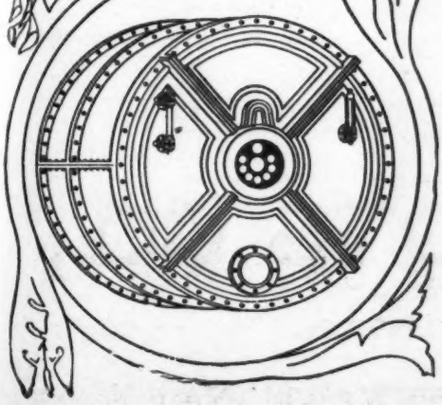

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AMERICAN METER CO.

ESTABLISHED 1834. INCORPORATED 1863.

NEW YORK AND PHILADELPHIA,

CHICAGO, ST. LOUIS,

SAN FRANCISCO.

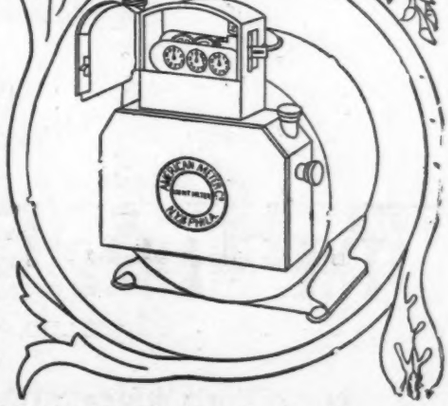
PUBLIC LIGHTING TABLE.

JUNE, 1896.

Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Extinguish.
				P.M.	A.M.
Mon.	1	7.50 PM	1.00 AM	7.15	3.15
Tue.	2	7.50 LQ	1.20	7.15	3.15
Wed.	3	7.50	1.40	7.15	3.15
Thu.	4	7.50	2.00	7.25	3.15
Fri.	5	7.50	2.20	7.25	3.15
Sat.	6	7.50	2.50	7.25	3.15
Sun.	7	8.00	3.30	7.25	3.15
Mon.	8	8.00	3.30	7.25	3.15
Tue.	9	8.00	3.30	7.25	3.15
Wed.	10	8.00 NM	3.30	7.25	3.15
Thu.	11	8.00	3.30	7.25	3.15
Fri.	12	8.00	3.30	7.25	3.15
Sat.	13	8.00	3.30	7.25	3.15
Sun.	14	8.00	3.30	7.25	3.15
Mon.	15	10.00	3.30	7.25	3.15
Tue.	16	10.20	3.30	7.25	3.15
Wed.	17	10.50 FQ	3.30	7.25	3.15
Thu.	18	11.10	3.30	7.30	3.15
Fri.	19	11.40	3.30	7.30	3.15
Sat.	20	12.10 AM	3.30	7.30	3.15
Sun.	21	12.50	3.30	7.30	3.15
Mon.	22	1.30	3.30	7.30	3.15
Tue.	23	No L.	No L.	7.30	3.15
Wed.	24	No L. FM	No L.	7.30	3.15
Thu.	25	No L.	No L.	7.30	3.15
Fri.	26	8.00 PM	10.00 PM	7.30	3.15
Sat.	27	8.00	10.30	7.30	3.15
Sun.	28	8.00	11.00	7.30	3.15
Mon.	29	8.00	11.20	7.30	3.15
Tue.	30	8.00	11.40	7.30	3.15

TOTAL HOURS LIGHTING DURING 1896.

By Table No. 1.	Hrs.Min.	By Table No. 2.	Hrs.Min.
January	220.40	January	423.20
February	207.00	February	367.40
March	193.00	March	355.35
April	174.10	April	298.50
May	164.00	May	264.50
June	142.10	June	234.25
July	142 10	July	243.45
August	150.50	August	280.25
September	163.00	September	321.15
October	193.10	October	374.30
November	207.00	November	401.40
December	237.30	December	433.45
Total, yr.	2194.40	Total, yr.	4000.00



P. H. & F. M. ROOTS CO.,

Connersville, Ind.

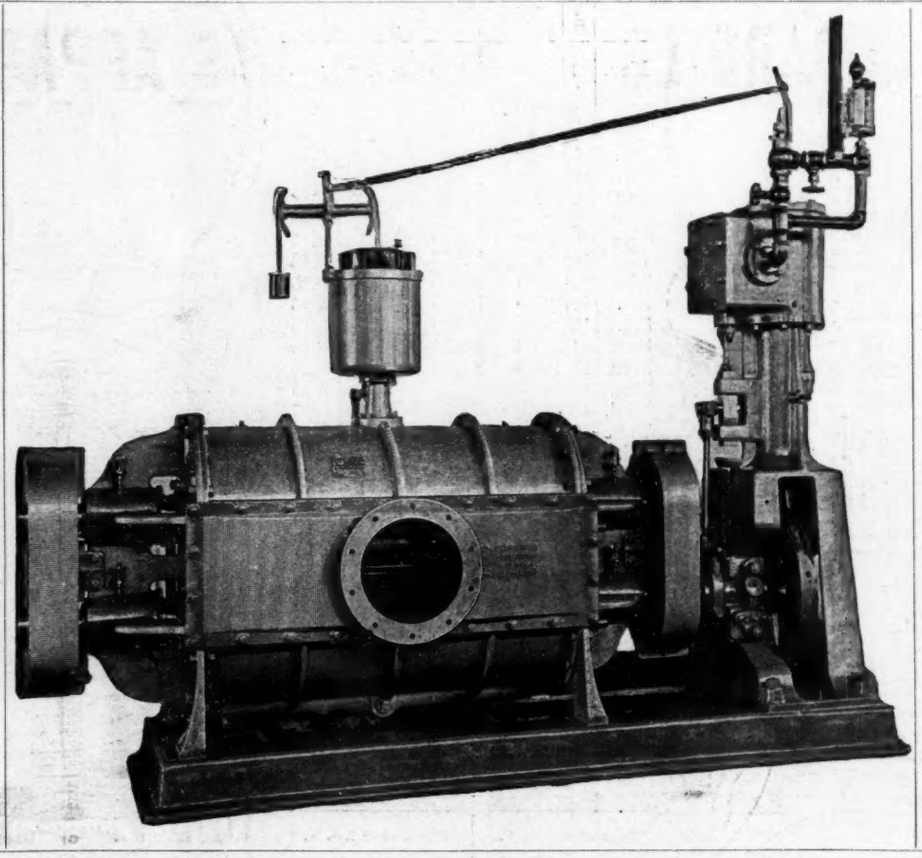
Exhausters with Combined Capacity of 75,000,000 Feet per Day Sold Last Season.

GAS EXHAUSTERS. BYE-PASS VALVES.

AUTOMATIC GAS GOVERNORS.

GAS VALVES. PIPE FITTINGS.

New Design of Direct Connected Engine and Exhauster on Same Bedplate.



This Design is Used for all Exhausters from No. 7 to No. 10, Inclusive.

Write for Illustrated Catalogue.
Estimates submitted on application.

P. H. & F. M. ROOTS CO.,

Connersville, Indiana.

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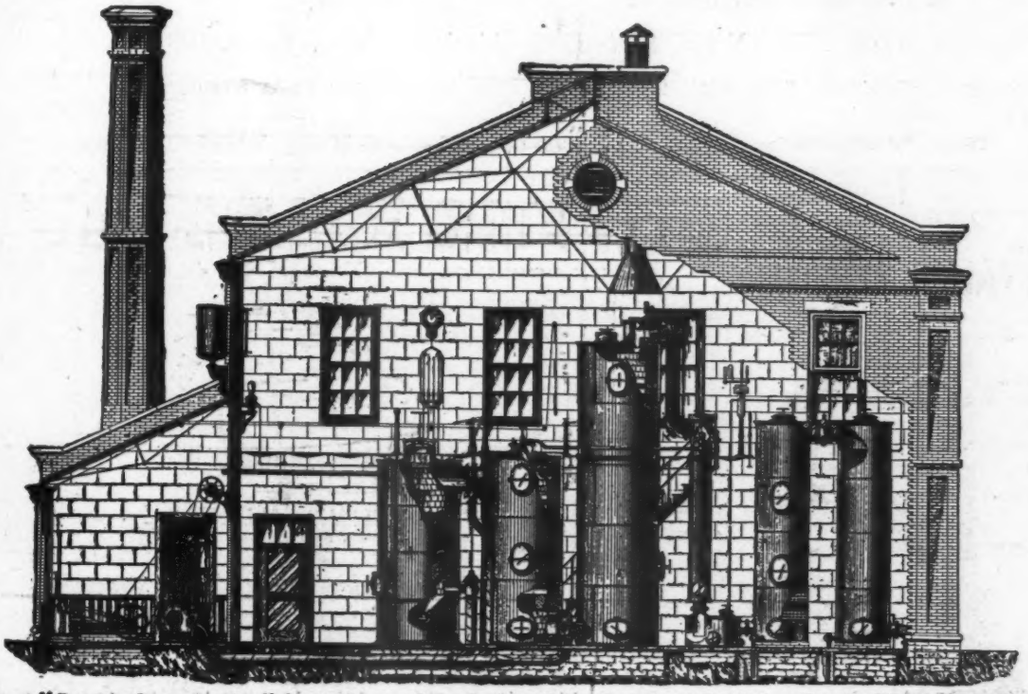

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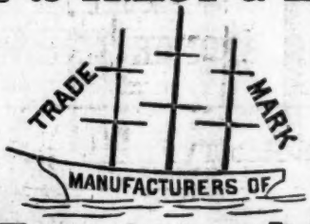

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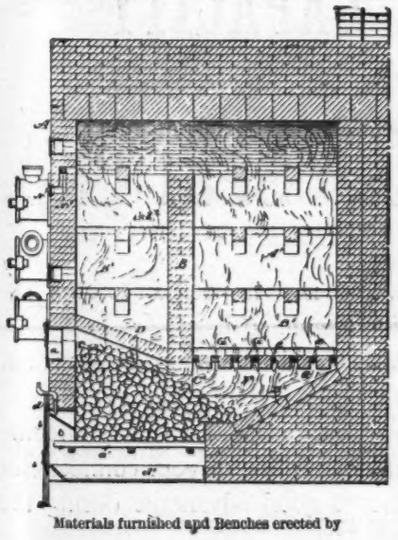

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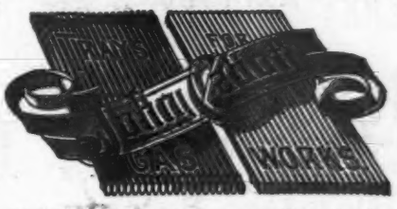

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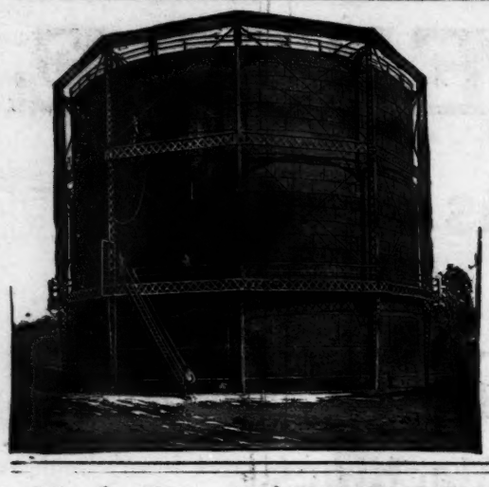

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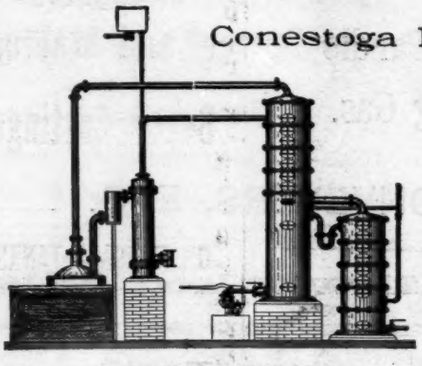

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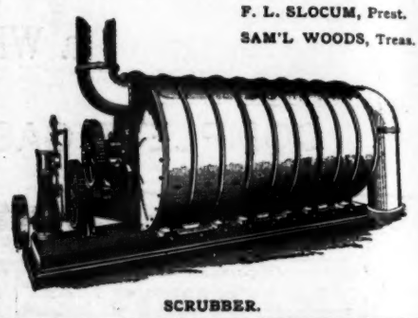

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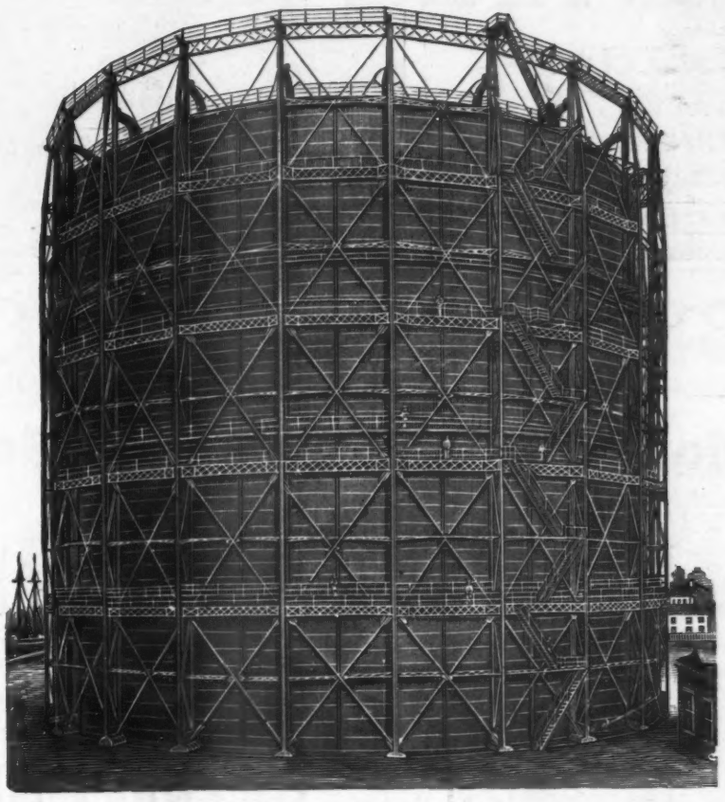

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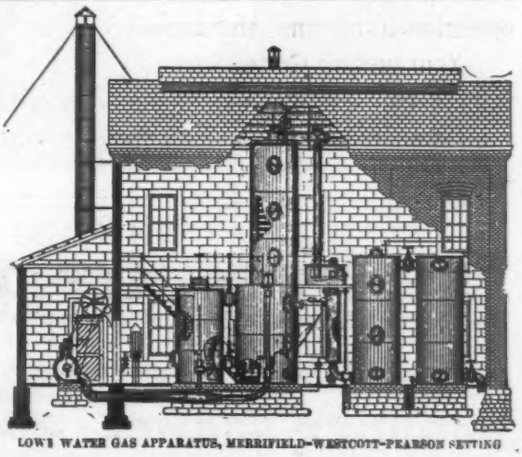

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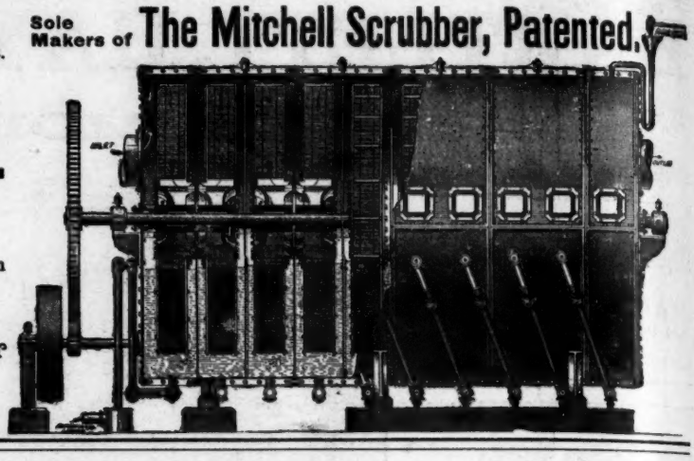

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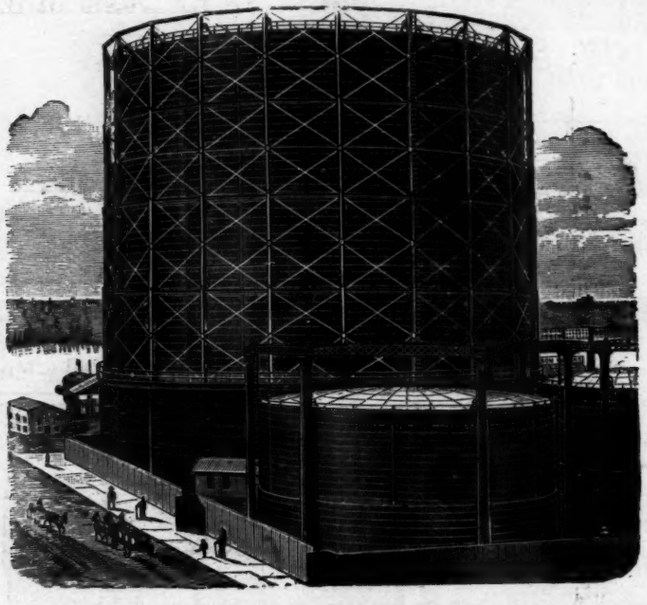

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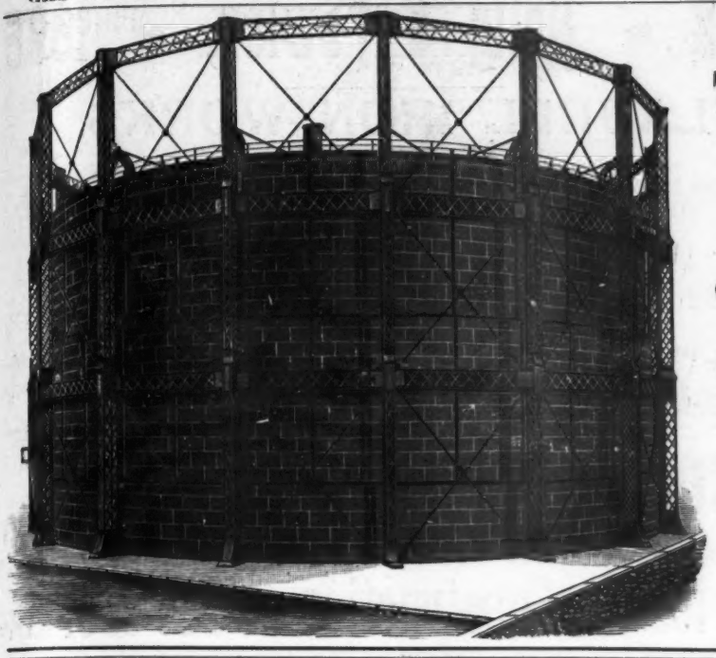

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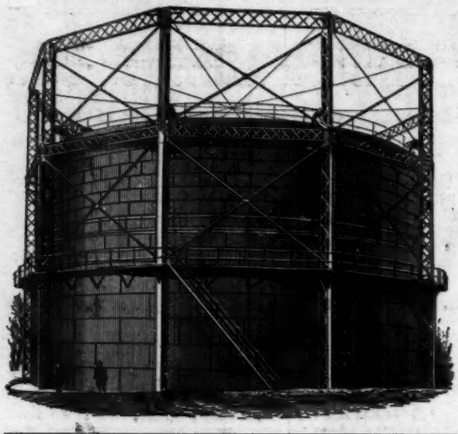

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